United States Patent [19]

Herten

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[54] **MACHINE FOR APPLYING ARTICLES OF HARDWARE TO TEXTILE MATERIALS AND THE LIKE**

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[73] Assignee: **William Prym-Werke KG**, Stolberg, Fed. Rep. of Germany

[21] Appl. No.: **729,616**

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[51] **Int. Cl.**[4] **A41H 37/10**

[52] **U.S. Cl.** **227/18**; 227/57; 227/119

[58] **Field of Search** 227/18, 36, 120, 124, 227/119, 152, 153, 77, 57

[56] **References Cited**

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Primary Examiner—James F. Coan

Attorney, Agent, or Firm—Peter K. Kontler

[57] **ABSTRACT**

Male or female annular components of fasteners are applied to articles of clothing in a machine wherein the lower tool of a pair of confronting tools has a socket for reception of the heads of discrete rivet-like connectors whose shanks extend upwardly toward the upper tool which has tongs with jaws for releasably holding a male or female component in such orientation that the central aperture of the component is in register with the shank of the connector in the socket of the lower tool. The upper tool further includes a ring-shaped hold-down device for the male or female component which is held by the tongs as well as a deforming plunger which can upset the tip of the shank after the latter has penetrated a garment between the two tools and thereupon through and partly beyond the aperture of the component in the tongs in response to downward movement of the upper tool. The hold-down device is movable axially relative to the tongs and the plunger is movable within limits axially of the hold-down device. The male and female components of fasteners are stored in discrete magazines and are fed to the tongs by devices whose operation can be blocked so that the tongs receive male or female components.

22 Claims, 21 Drawing Figures

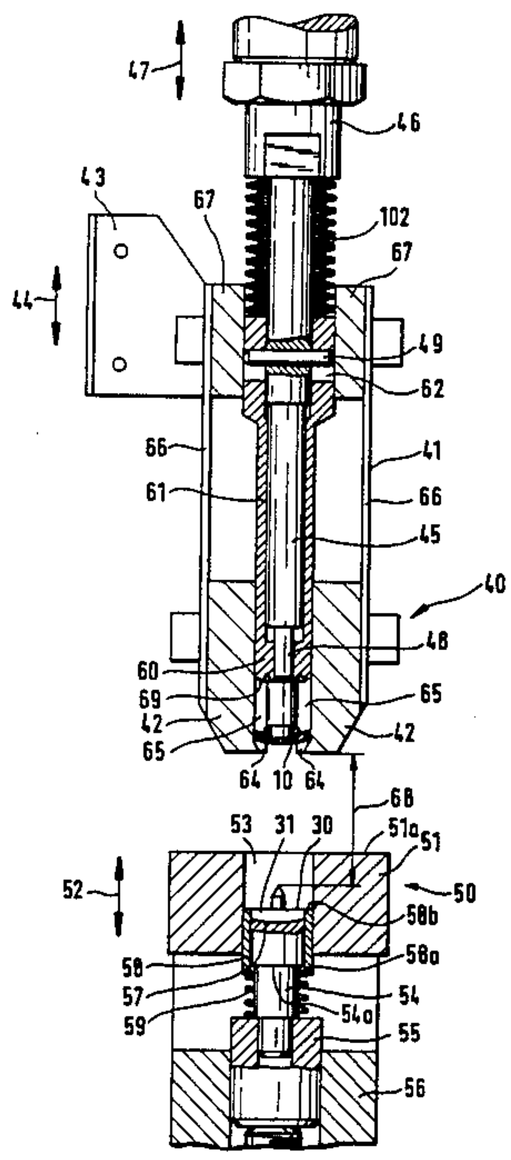


FIG. 2

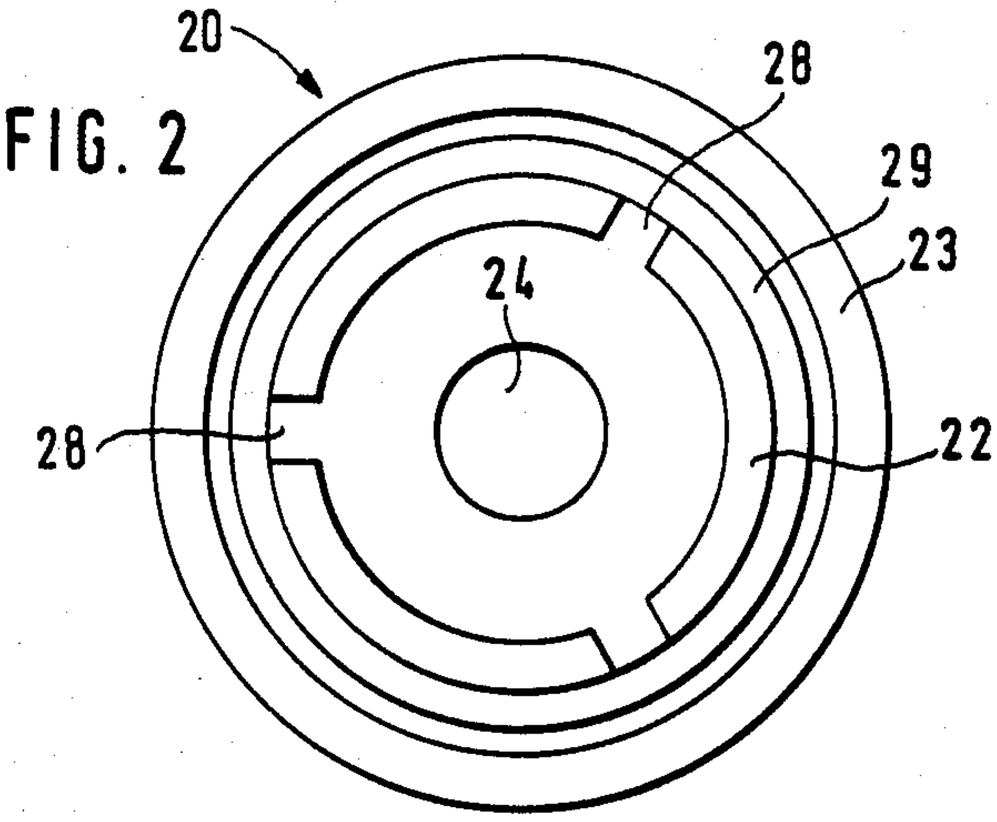


FIG. 1

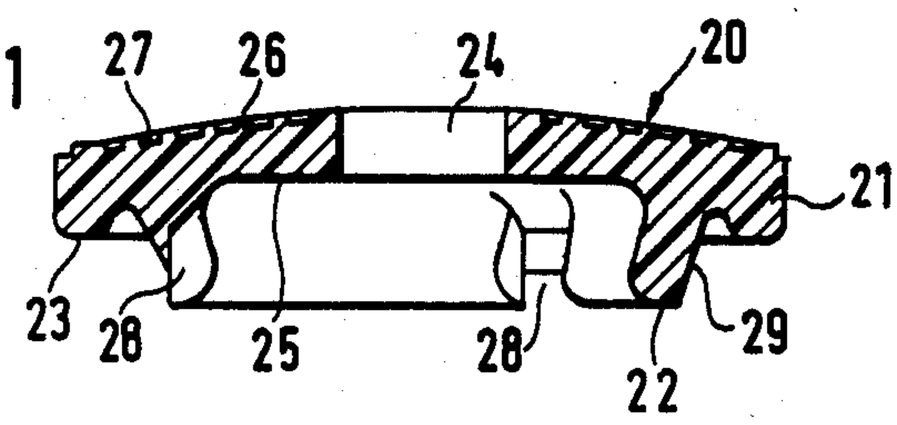


FIG. 4

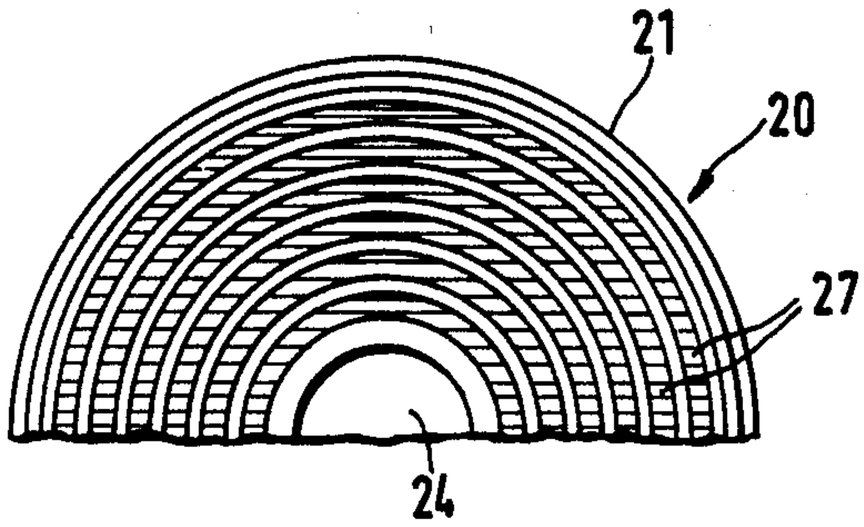


FIG. 3

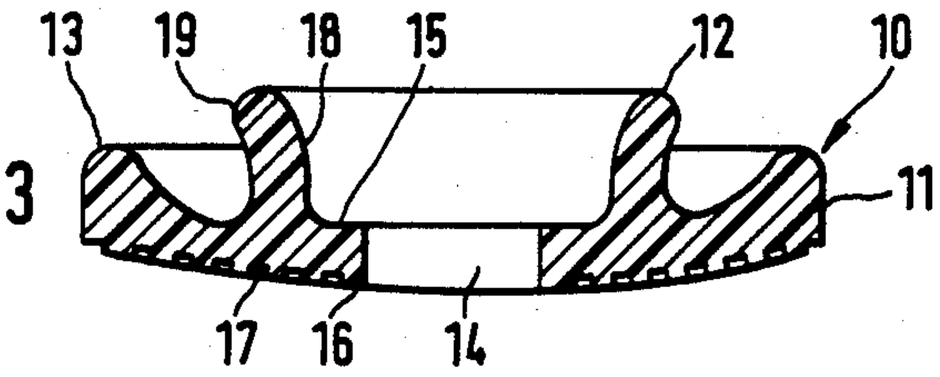
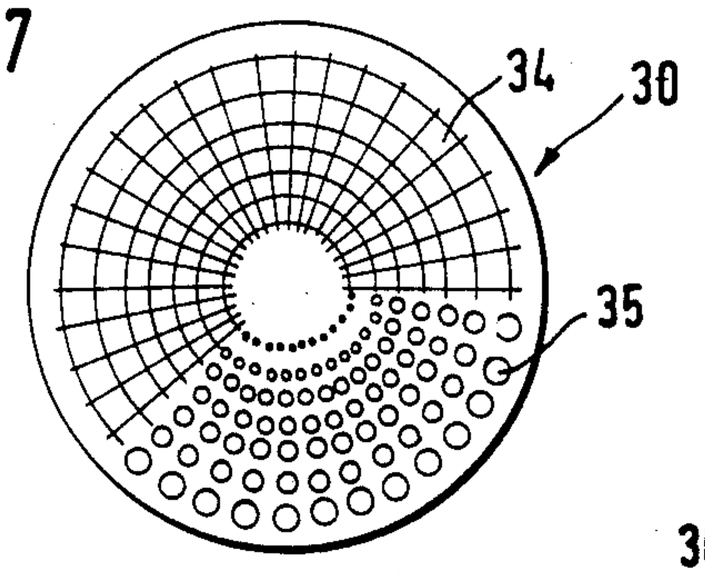


FIG. 7



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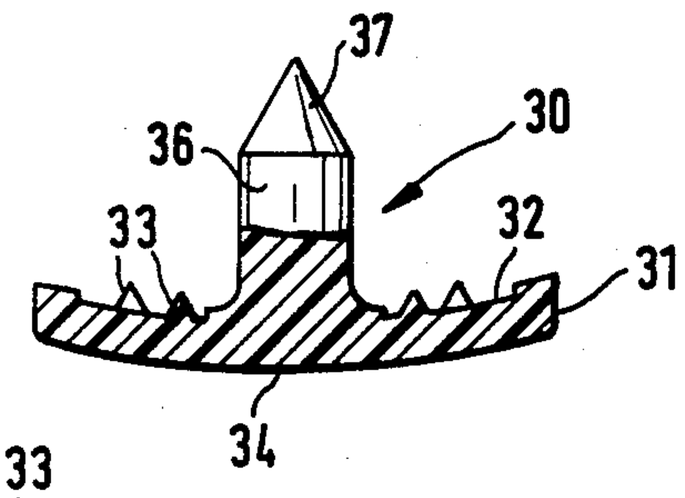


FIG. 6

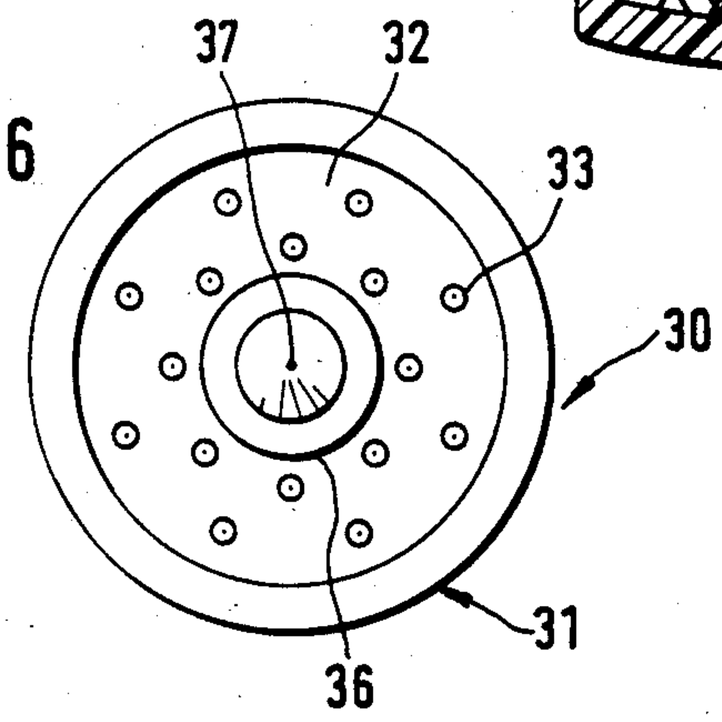
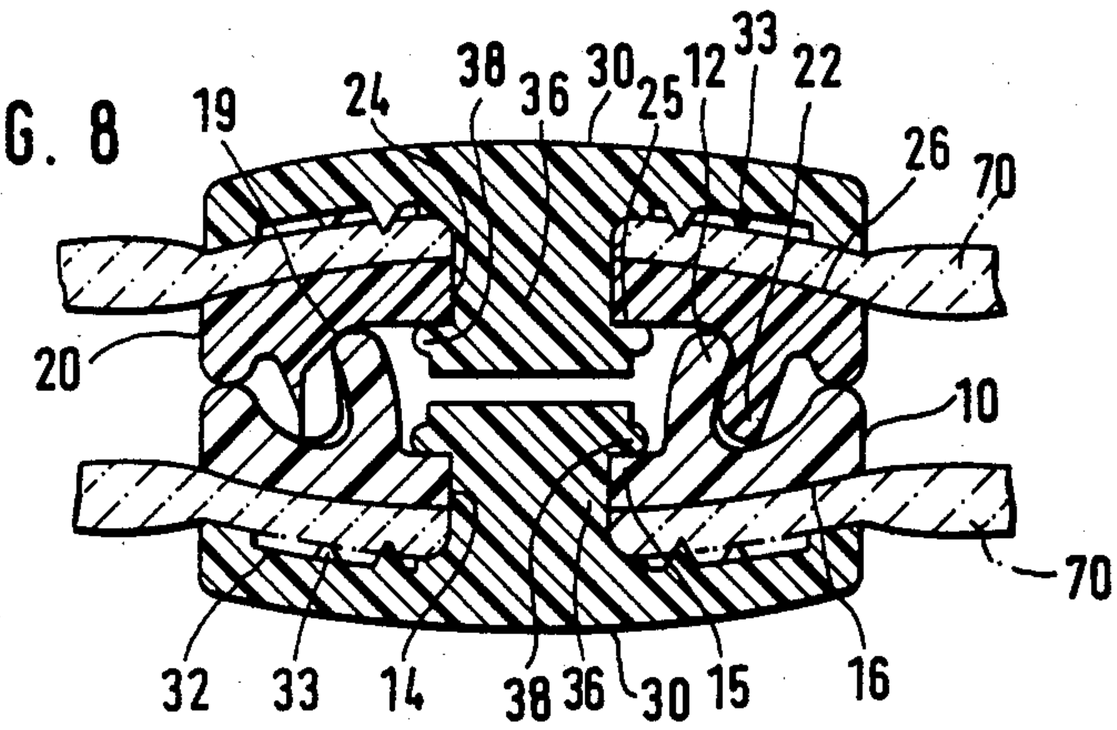


FIG. 8



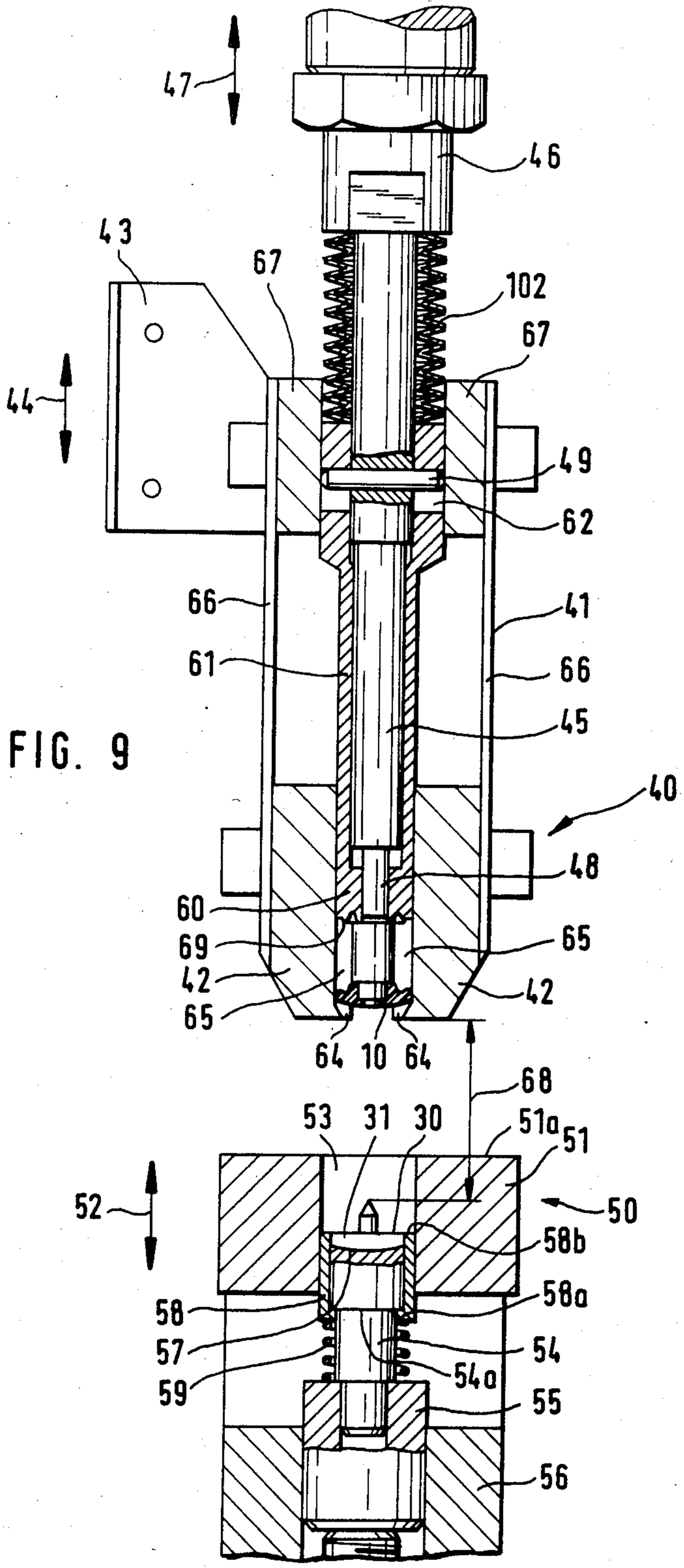

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FIG. 9

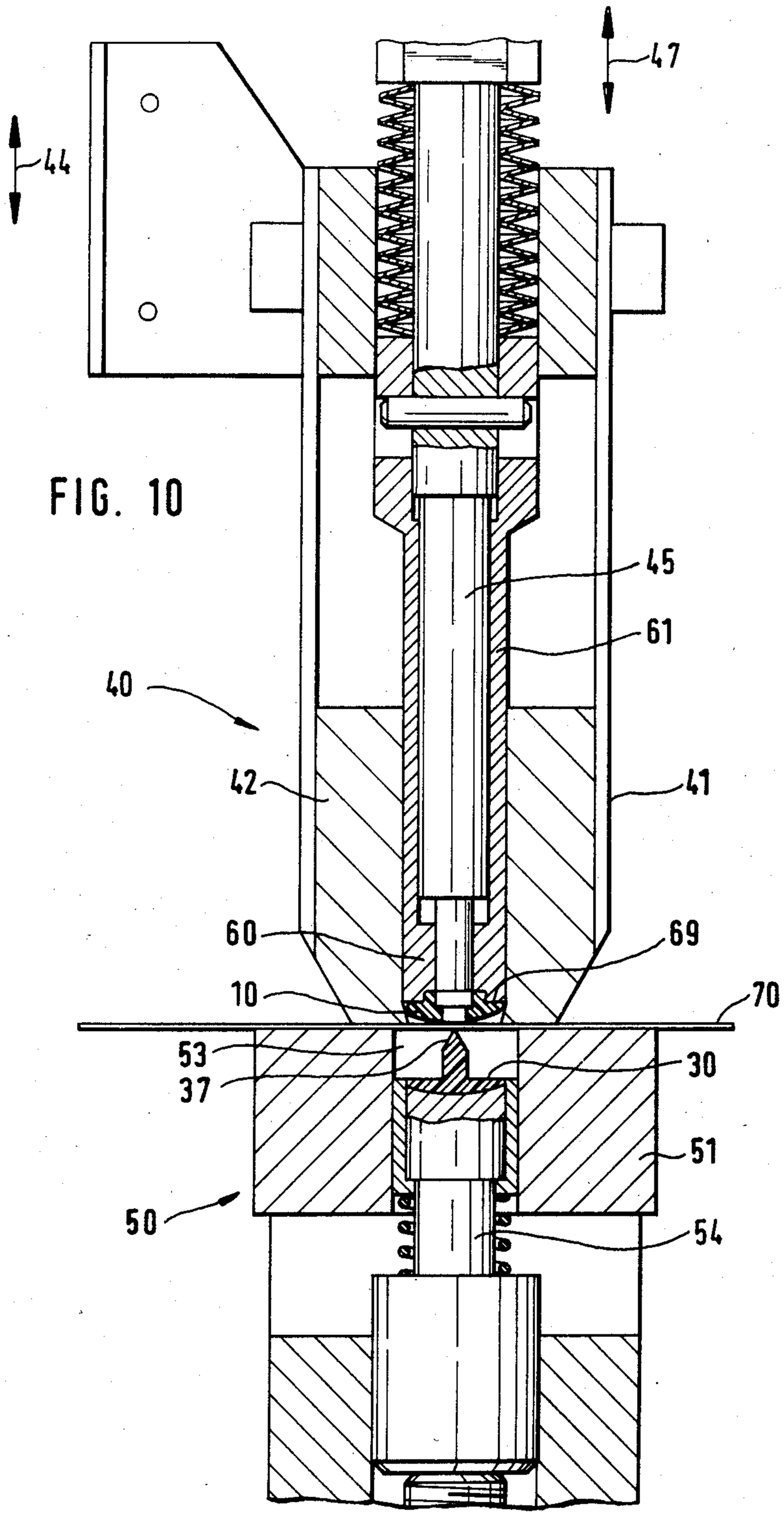

FIG. 10

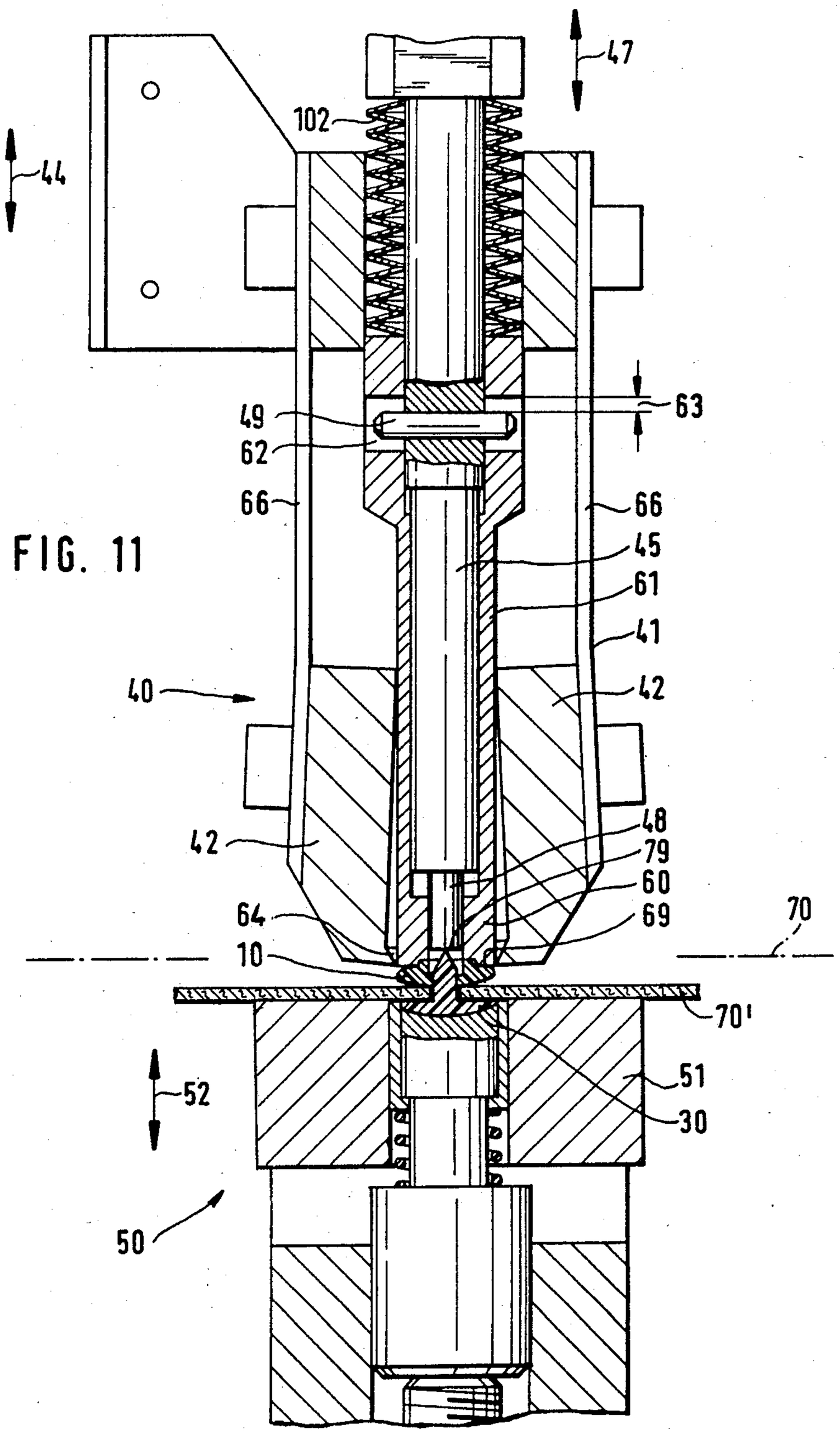
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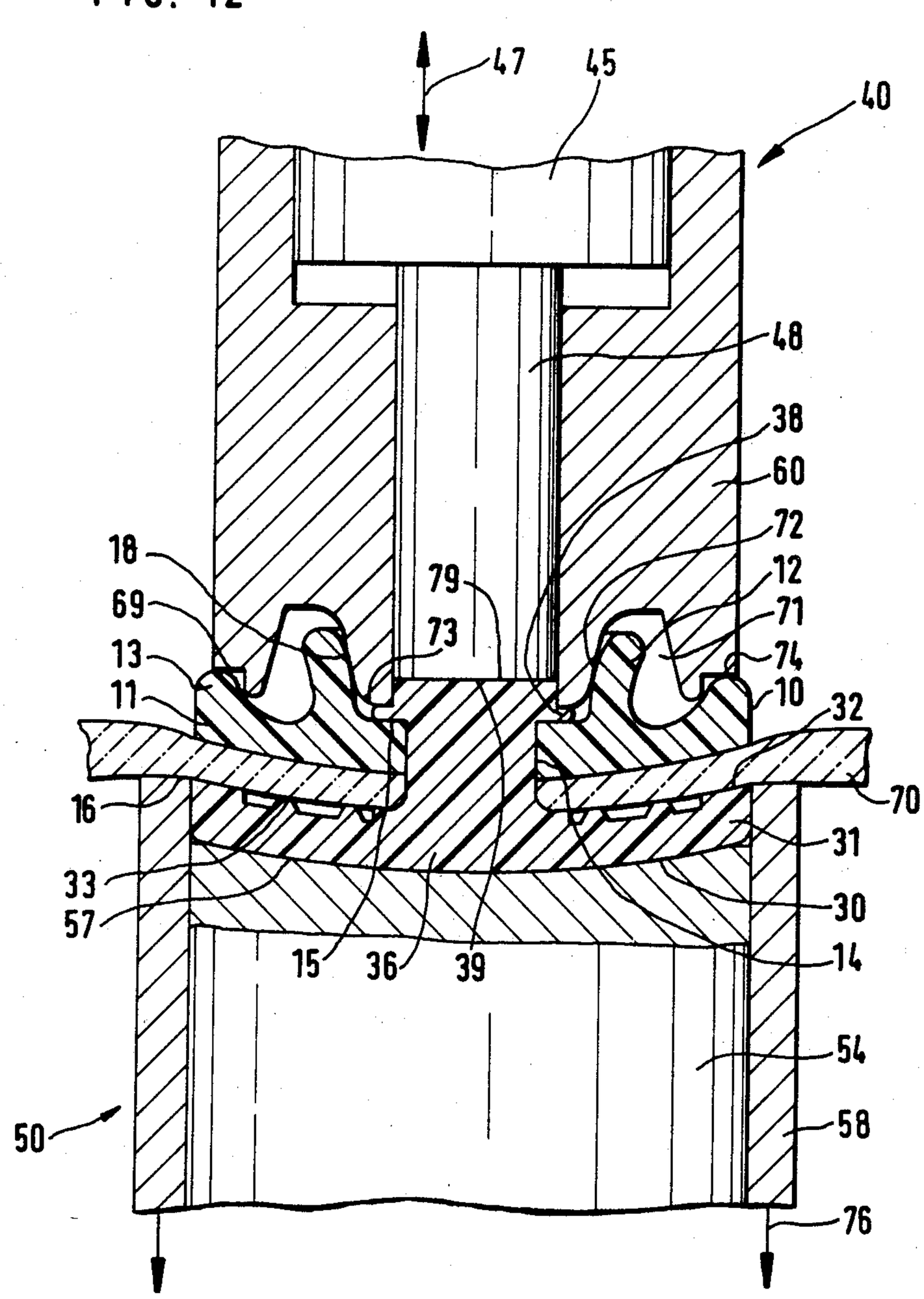
FIG. 11

FIG. 12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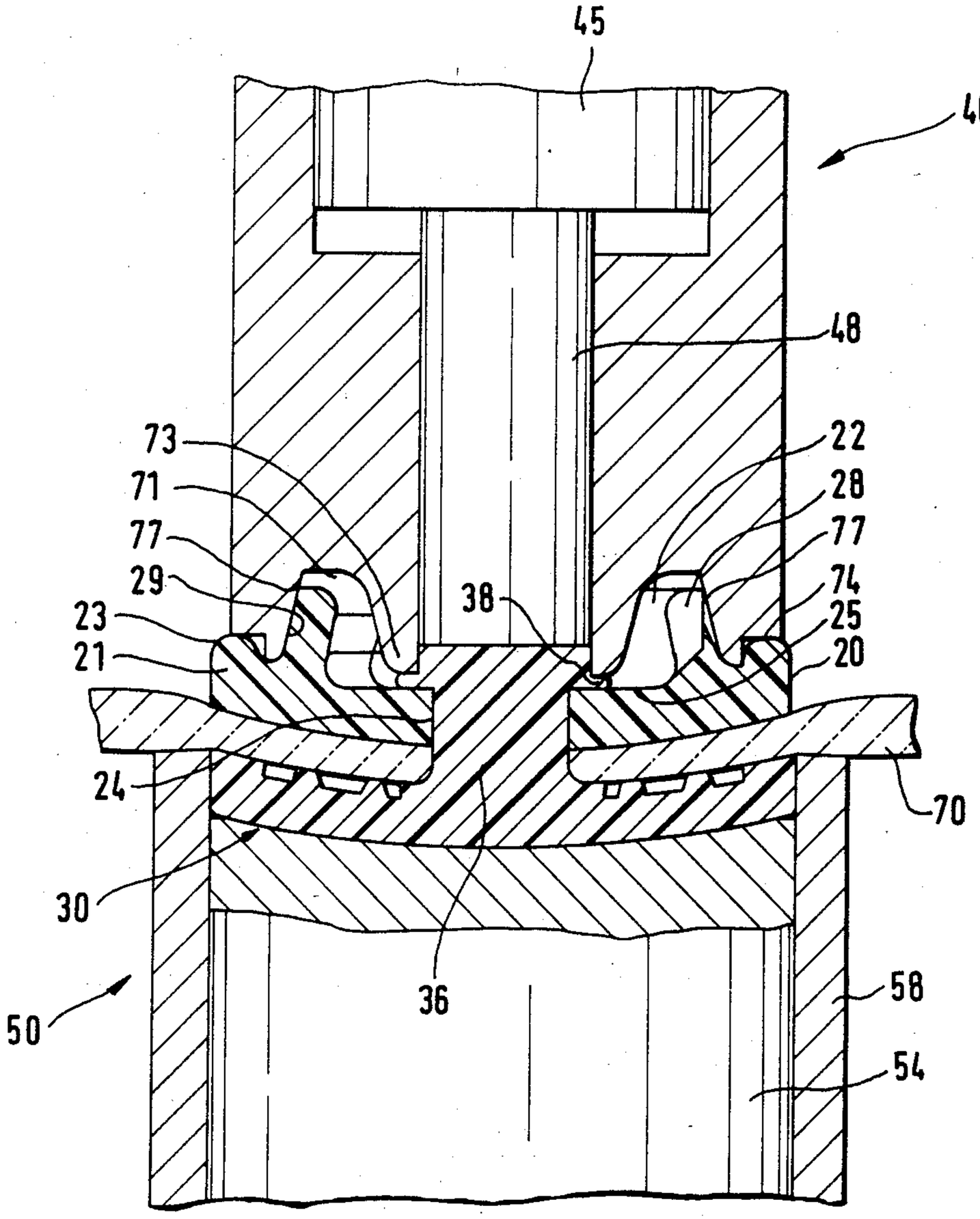

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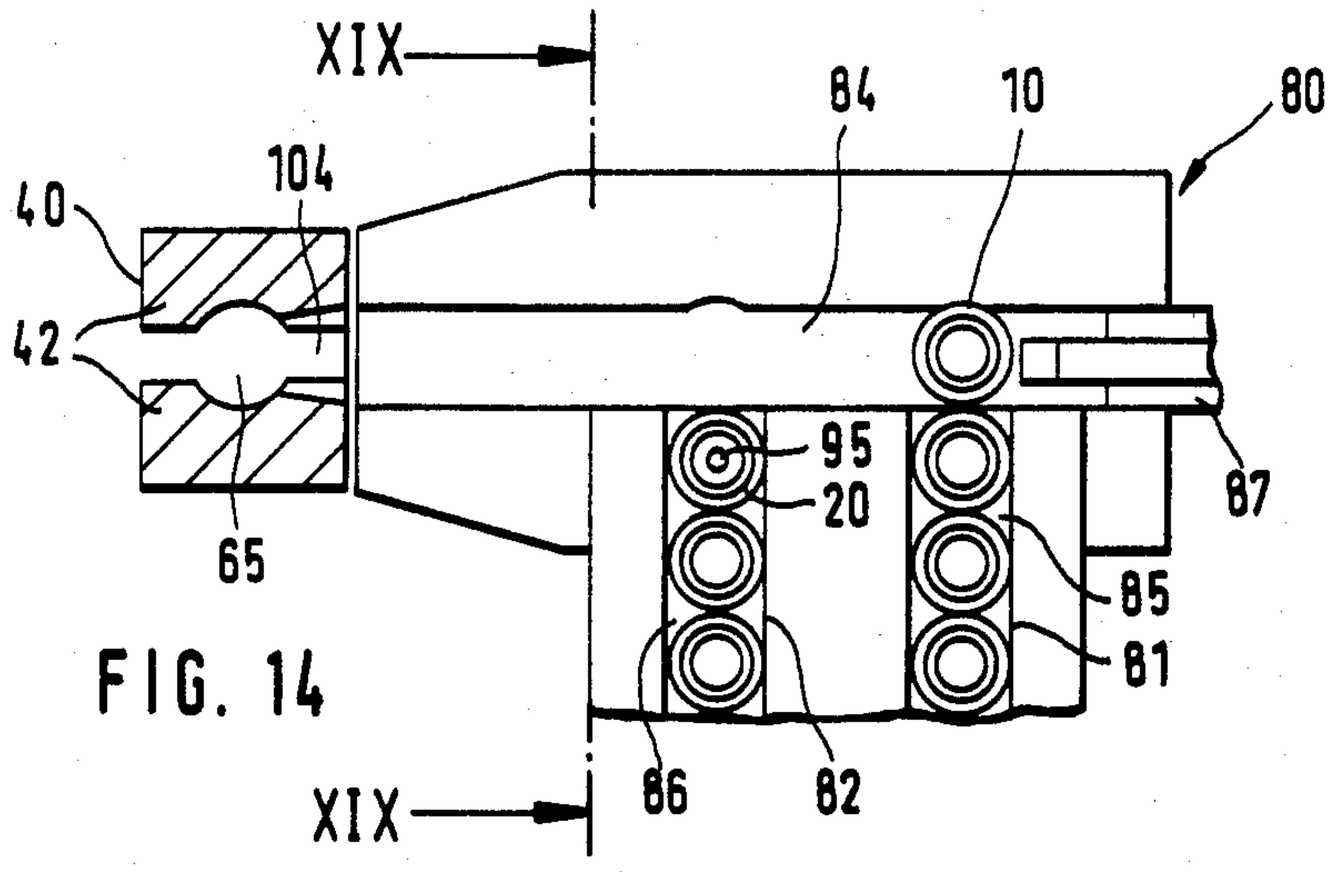
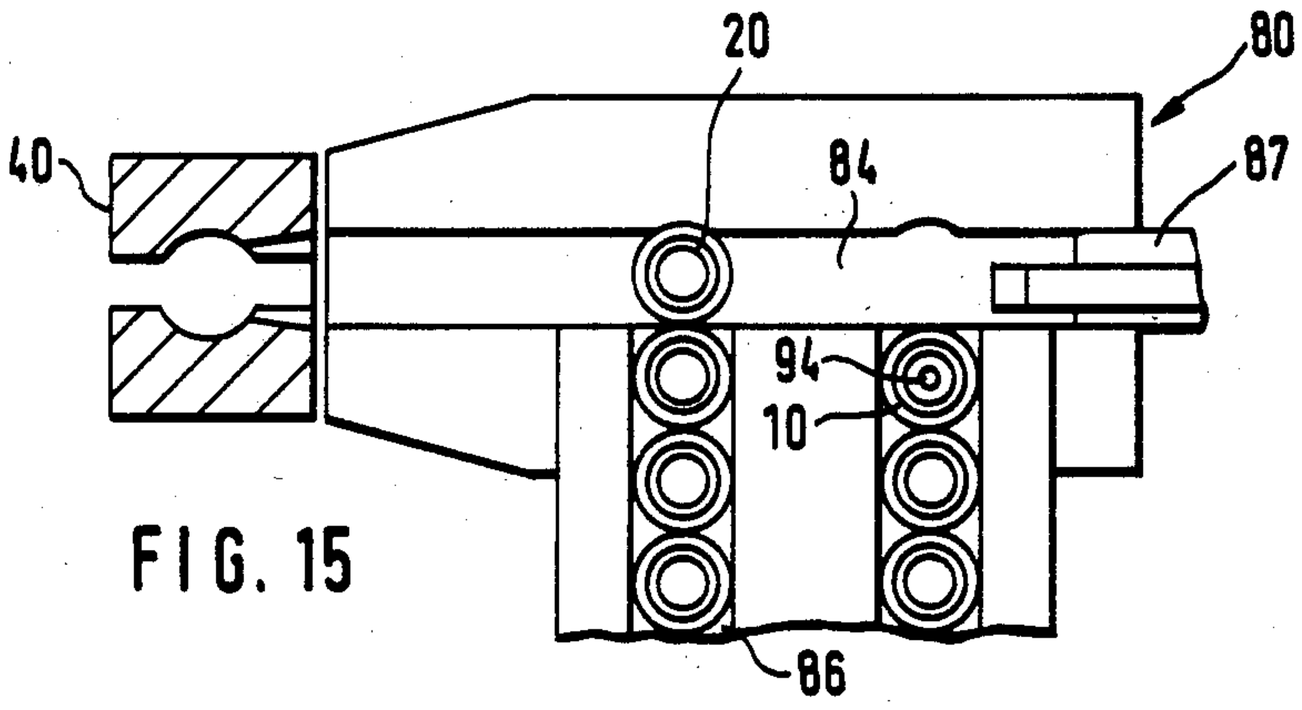


FIG. 14



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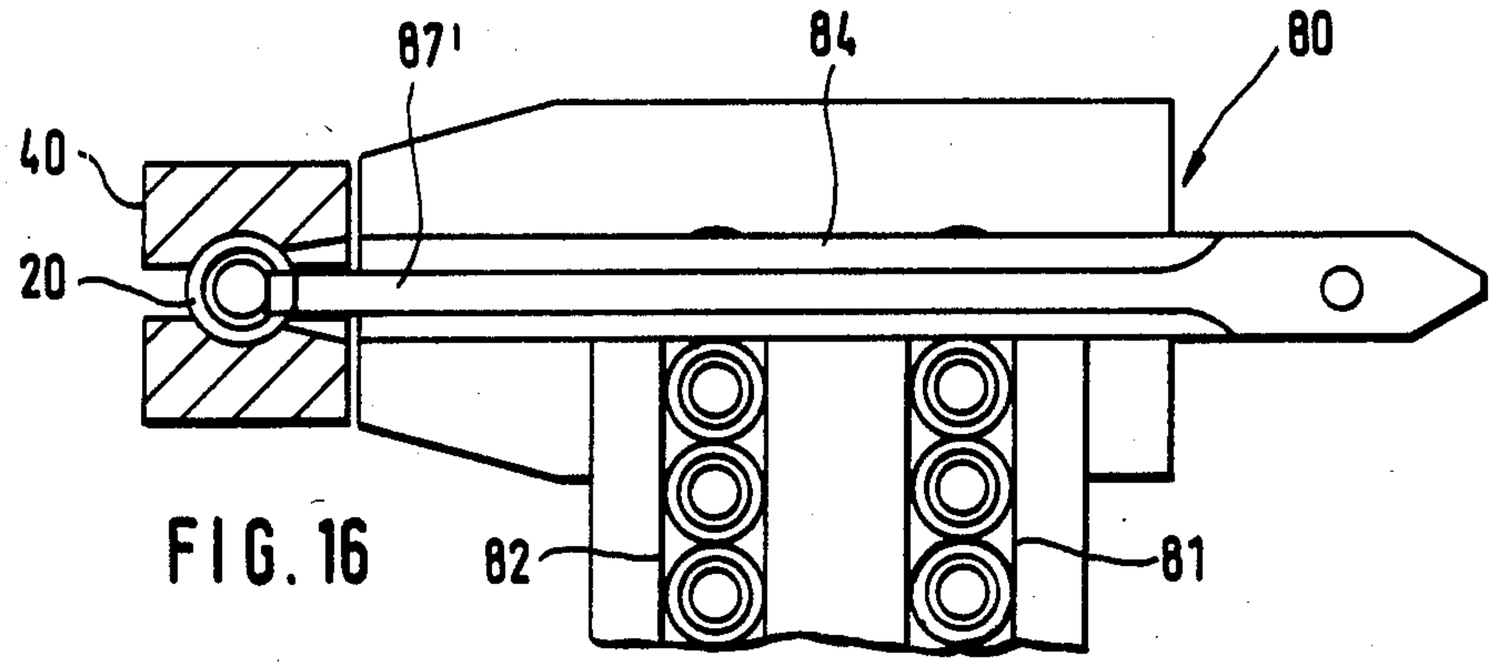

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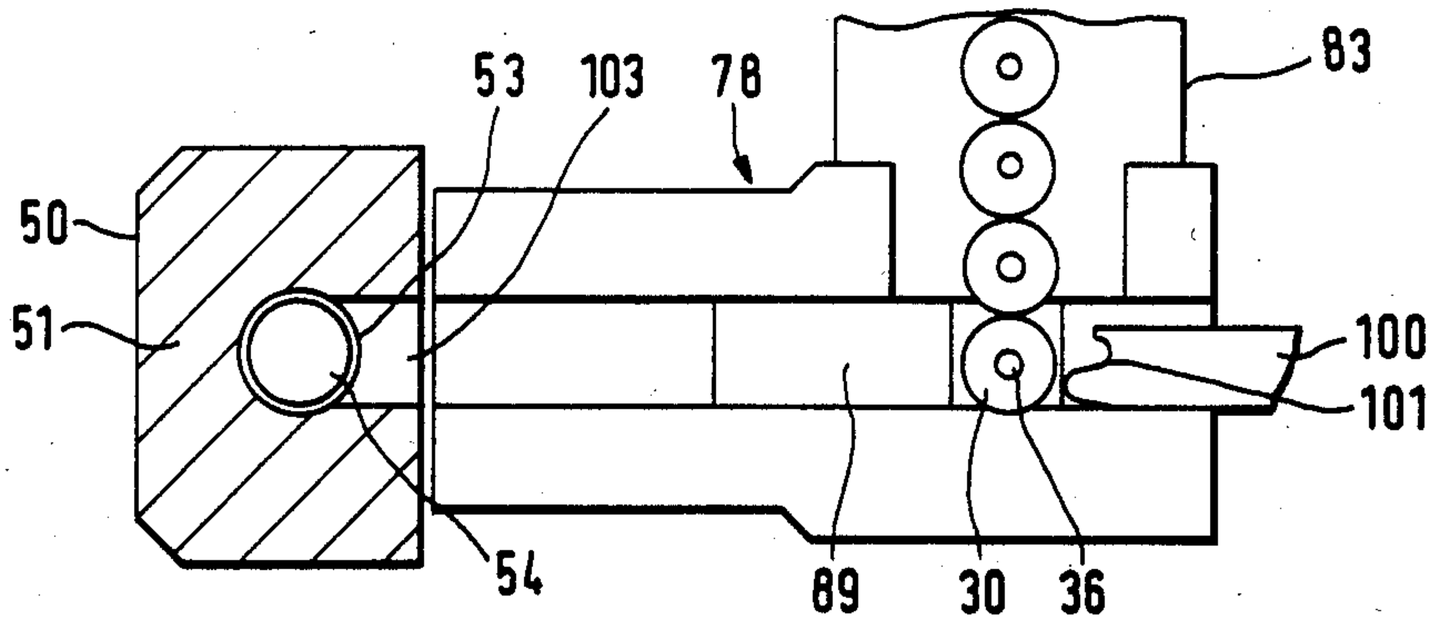
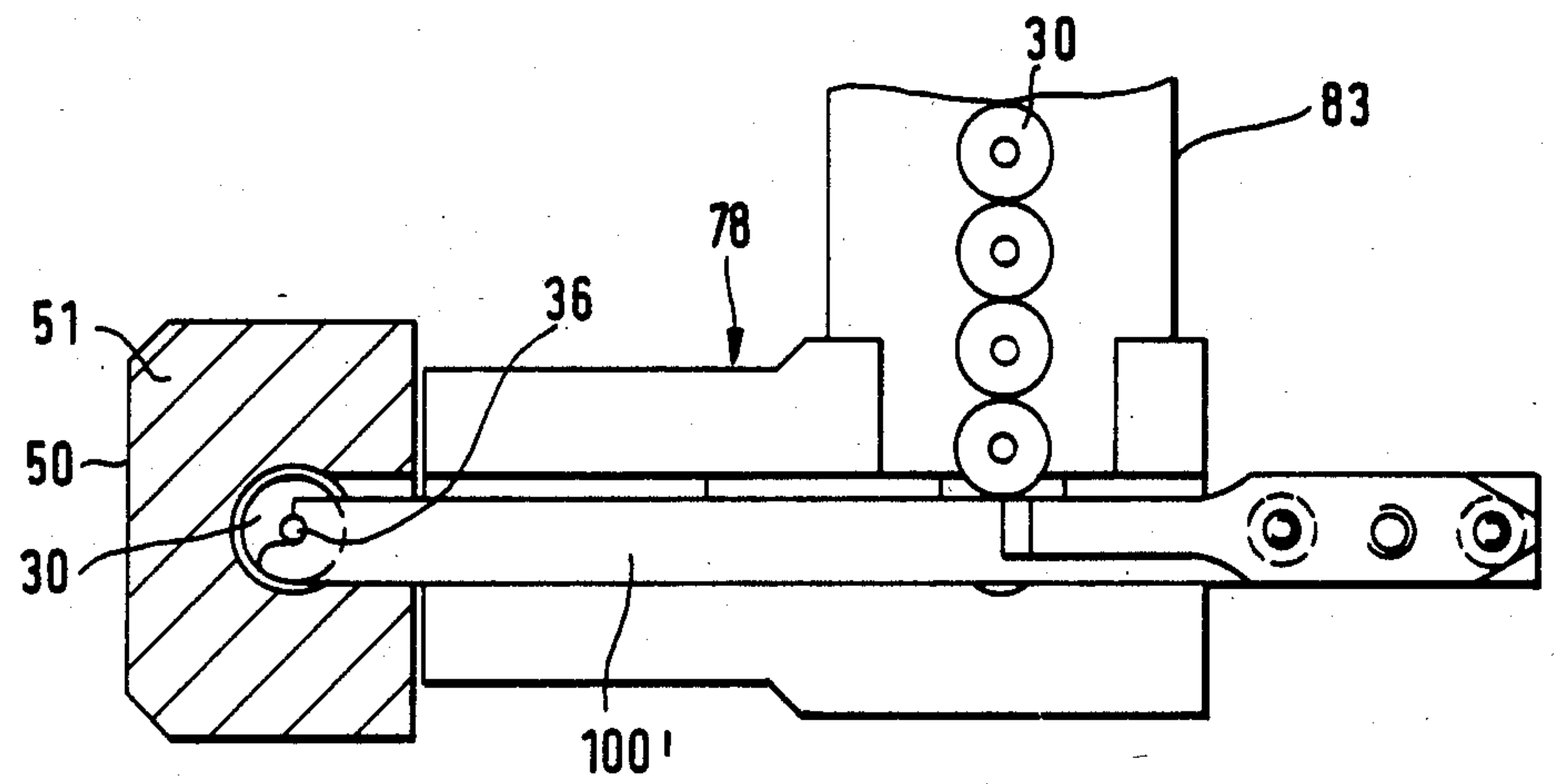
FIG. 17





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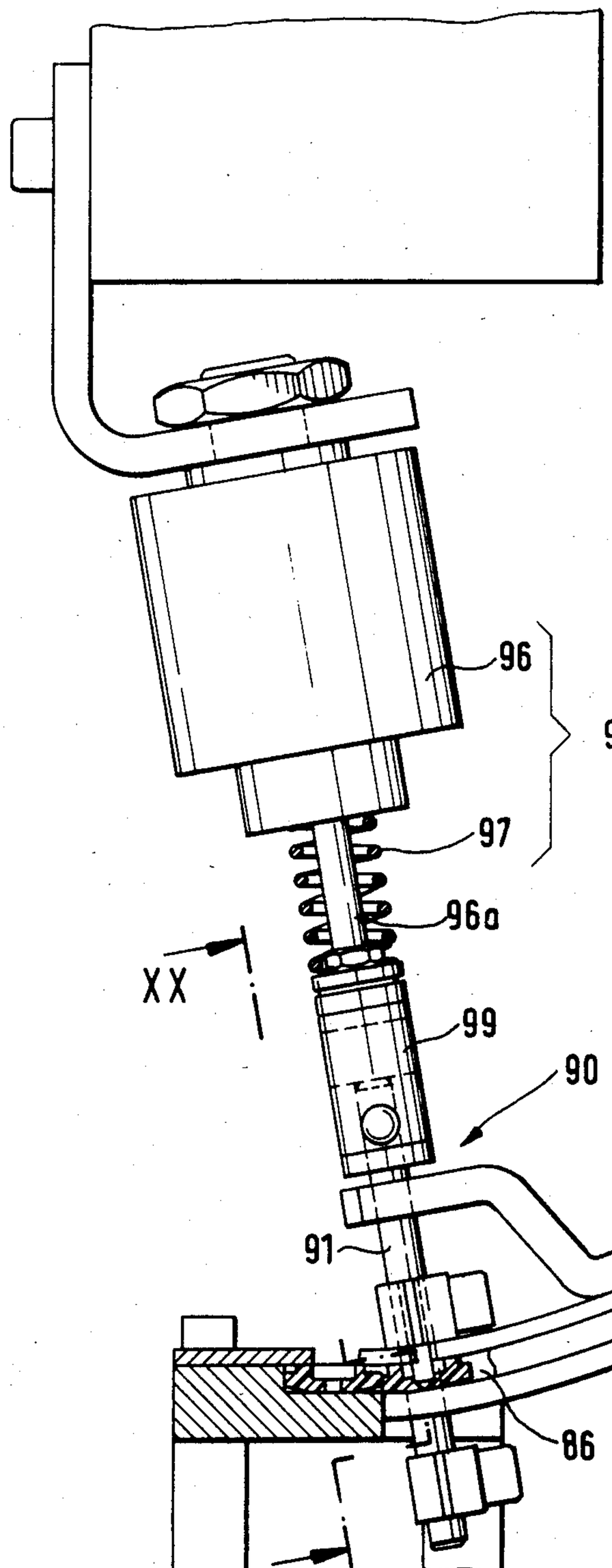
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FIG. 19

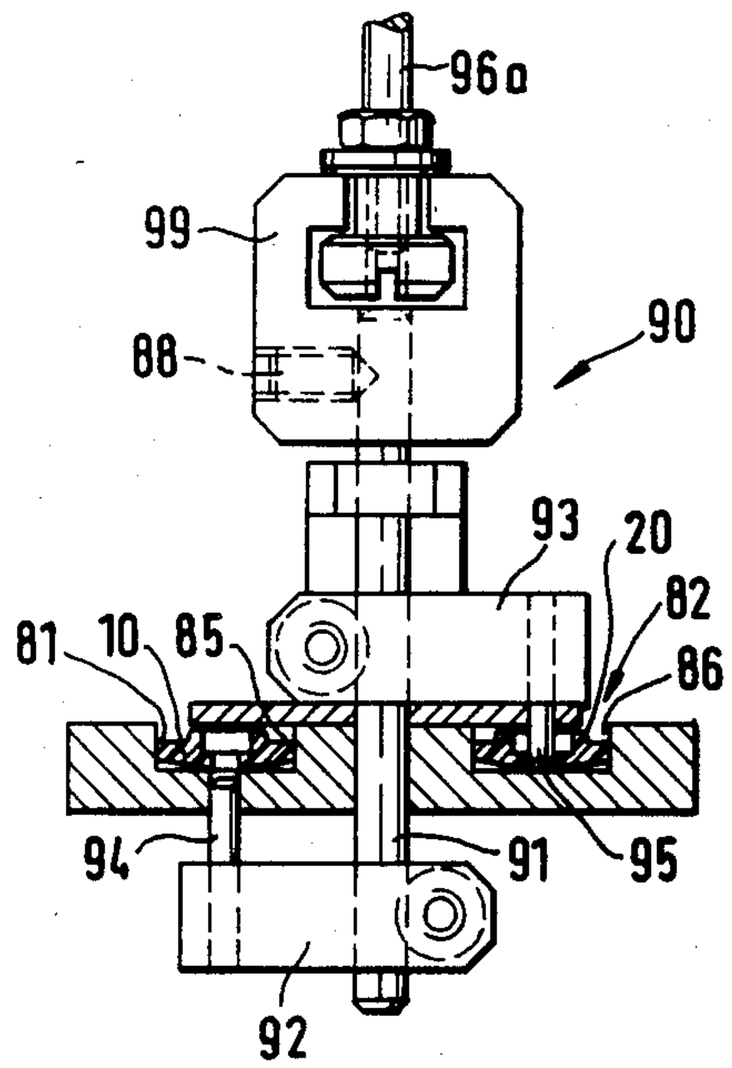
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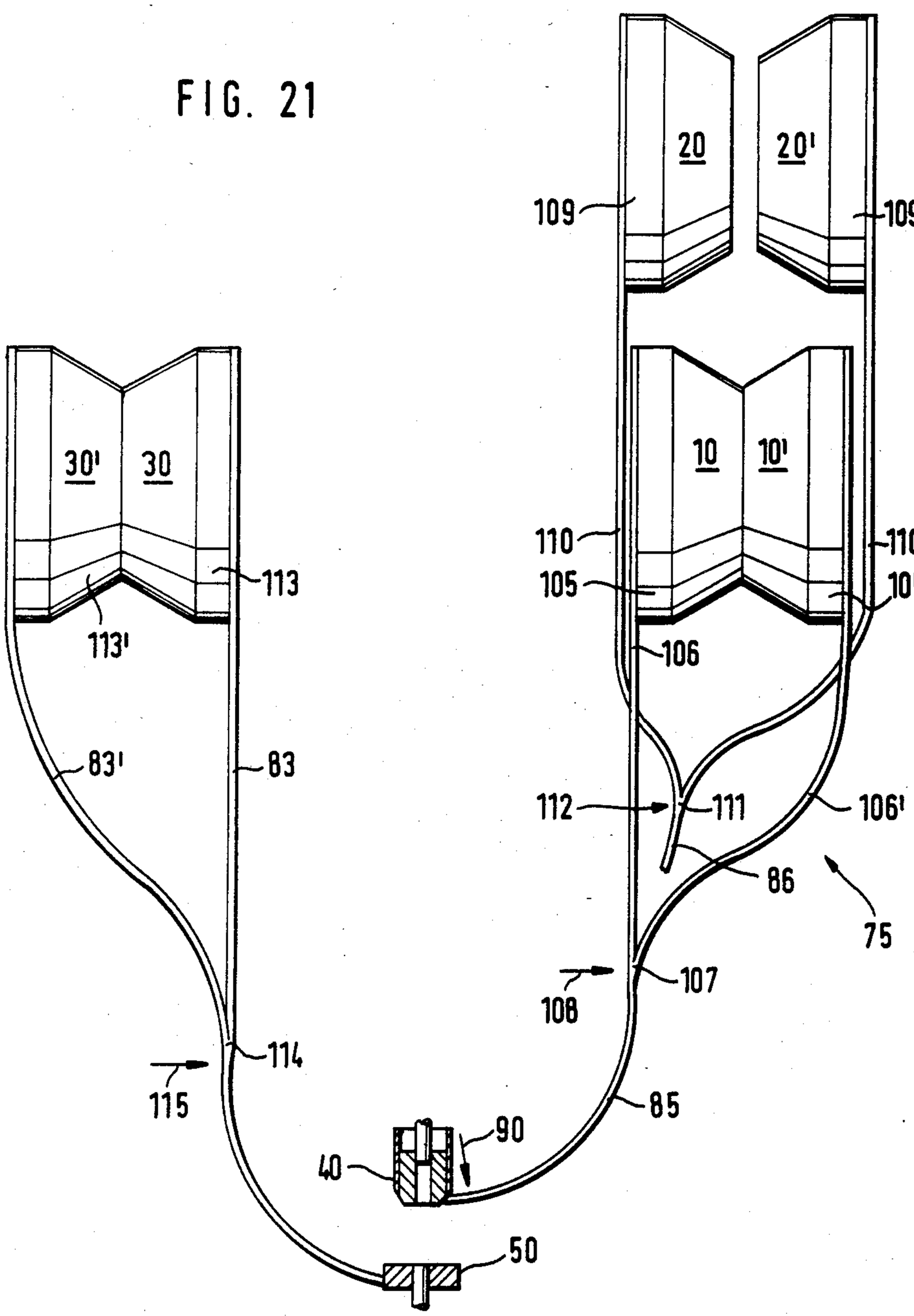
FIG. 20

FIG. 21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MACHINE FOR APPLYING ARTICLES OF HARDWARE TO TEXTILE MATERIALS AND THE LIKE

CROSS-REFERENCE TO RELATED CASES

Snap fastener units similar to those which are treated in the riveting press of the present invention are disclosed in the commonly owned copending patent application Ser. No. 655,048 filed Sept. 26, 1984 by Bernhard Nysten et al. for "Snap fastener unit". Riveting presses which are somewhat similar to the riveting press of the present invention are disclosed in the commonly owned copending patent application Ser. No. 599,176 filed Apr. 11, 1984 by Ernst Herten for "Machine for applying articles of Hardware to textile materials and the like" and in the commonly owned copending patent application Ser. No. 599,172 filed Apr. 11, 1984 by Ernst Herten et al. for "Riveting press". An apparatus for feeding articles of hardware in riveting presses of the class to which the present invention belongs is disclosed in the commonly owned copending patent application Ser. No. 598,990 filed Apr. 11, 1984 by Paul Hagmann for "Apparatus for feeding articles of hardware in riveting presses and the like".

BACKGROUND OF THE INVENTION

The present invention relates to improvements in machines for applying components of fasteners to penetrable carriers, e.g., to panels, webs or sheets of textile or plastic material. More particularly, the invention relates to improvements in machines of the type wherein components of fasteners can be secured to carriers by means of rivet-shaped connectors. Such fasteners are often applied to jeans, jackets, shirts, blouses, overalls and/or other articles of apparel for utilitarian and/or decorative purposes.

As a rule, each fastener of the type whose components are to be treated in the machine of the present invention has a male component and a female component. The male component can be separably connected with the corresponding female component, e.g., to prevent access to a pocket, to hold down a collar, to button down the sleeve of a jacket or shirt, or for purely decorative purposes. The male and female components are applied to one side of the carrier opposite the respective connectors which have rivet heads located at the other side of the carrier as well as shanks which extend through the carrier and are deformed into more or less permanent engagement with the respective (male or female) components of fasteners. As a rule, the male and female components of fasteners are formed with centrally located apertures for the shanks of the respective connectors, and the tips of the shanks are upset so as to overlie portions of the exposed sides of the components to thereby prevent axial movements of the components and the respective connectors relative to each other as well as to securely clamp a portion of the carrier between each male or female component and the respective connector. The female components of fasteners have suitably configurated coupling elements which can be brought into engagement with complementary (i.e., different) coupling elements of the male components. The coupling elements can constitute annuli which extend from exposed sides of the respective (male and female) components, and the coupling element of a male component can penetrate (e.g., by snap action) into the coupling element of a female component to thus complete the assembly of a two-piece fastener. The coupling elements of the male and female components act not unlike male and female detent means and can exhibit a certain amount of resiliency so that they can remain in reliable engagement with one another but can be separated in response to the application of a requisite force.

Male and female components of the above outlined fasteners are assembled with rivet-like connectors in discrete riveting presses or analogous machines. A first press is used to assemble male components of fasteners with suitable connectors, and a second press is employed to assemble connectors with female components. Each press is normally provided with means for automatically feeding male or female components and connectors to the assembling station between two relatively movable confronting tools one of which supports the connector and the other of which supports the male or female component and is designed to deform the shank of the connector as soon as the latter assumes an optimum position with reference to the male or female component.

A drawback of such mode of applying male and female components of fasteners to articles of clothing or the like is that each garment must be treated in a first machine wherein the garment is provided with male or female components and thereupon in a discrete second machine wherein the garment is provided with female or male components of fasteners. The utilization of two discrete machines is deemed necessary because the female components of fasteners are not identical with the male components so that the application of male components necessitates the use of a first set of tools whereas the application of female components necessitates the use of a different second set of tools. The utilization of two discrete riveting presses or analogous machines not only contributes to initial and maintenance cost but also to the cost of the garments because the application of male and female components of fasteners in two different machines is a time-consuming operation. Proposals to replace a first set of tools with a different second set of tools in order to allow for the application of male and female components on one and the same machine have met with little success in the relevant industry because the conversion of a single machine for the application of male or female components is complex and takes up long intervals of time with attendant pronounced losses in output.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the invention is to provide a riveting press or an analogous machine which is constructed and assembled in such a way that it can apply male or female components of fasteners to one and the same carrier without the need for a change of setup.

Another object of the invention is to provide a machine which can be used for the application of different types of male and/or female components of fasteners to articles of clothing or the like.

A further object of the invention is to provide a machine which can assemble male or female components of fasteners with one and the same type of connectors or with two or more different types of connectors without any changes in the setup.

An additional object of the invention is to provide a machine wherein one and the same set of tools can be

used to assemble one or more types of male or female components of fasteners with one or more types of connectors.

Still another object of the invention is to provide a machine of the above outlined character with novel and improved tools which can be used for the application of male or female components of fasteners.

A further object of the invention is to provide novel and improved male and female components of fasteners for the application to articles of clothing or the like in a machine of the above outlined character.

An additional object of the invention is to provide novel and improved connectors for use in the above outlined machine as a means for securing male or female components of fasteners to carriers of penetrable textile or plastic material.

A further object of the invention is to provide novel and improved means for supplying male and female components of fasteners and connectors into the range of tools in a machine of the above outlined character.

Still another object of the invention is to provide a novel and improved method of attaching male or female components of fasteners to penetrable carriers which consist of a textile or like material.

Another object of the invention is to provide a machine whose output is much higher than the output of heretofore known batteries of machines for the application of male and female components of fasteners to articles of clothing or the like.

A further object of the invention is to provide the machine with novel and improved means for regulating the delivery of selected male and/or female components of fasteners and/or selected types of connectors into the range of tools which are used to assemble male or female components with rivet-like connectors.

An additional object of the invention is to provide the machine with novel and improved means for blocking the admission of unwanted components and/or connectors to the station where the selected components are attached to their carriers.

The invention is embodied in a machine for selectively applying centrally apertured annular male and female components of fasteners to penetrable carriers (especially to panels or sheets of textile material) by means of connectors of the type having a rivet head and a deformable shank which extends from one side of the rivet head. The machine comprises confronting first and second tools and means for moving one of the tools relative to the other tool between a retracted position in which a carrier can be inserted between the two tools and an extended position in which the tools cooperate to secure a connector to a male or female component, with a portion of the carrier therebetween. The first tool (which can be disposed at a level below the second tool) has a socket for reception of the heads of discrete connectors in such orientation that the shank of the connector in the socket extends toward the second tool and penetrates through the carrier between the two tools on movement of the one tool toward its extended position. The second tool comprises gripper means (e.g., a tongs with two jaws which are movable toward and away from each other) for releasably holding a male or female component in such orientation that the aperture of the component which is held by the gripper means registers with and receives the shank of the connector in the socket of the first tool in response to movement of the one tool toward the extended position. The second tool further comprises a deforming member which is movable with reference to the gripper means during movement of the one tool toward the extended position so as to deform the shank of the connector in the socket subsequent to penetration of such shank first through the carrier between the two tools and thereupon through and partially beyond the aperture of the male or female component which is held by the gripper means. The machine further comprises means for introducing discrete connectors into the socket in successive retracted positions of the one tool, and means for deliverying discrete male or female components to the gripper means in successive retracted positions of the one tool.

The second tool preferably further comprises a back support which serves to hold down the component which is held by the gripper means during penetration of the shank of a connector through and partly beyond the aperture of such component as well as during subsequent deformation of the shank.

The male and female components of fasteners preferably have at least substantially identically dimensioned outer marginal portions which are engageable by the gripper means, and the male and female components respectively have annular male and female coupling elements which face away from the first tool (namely toward the aforementioned back support) while the respective marginal portions are held by the gripper means. The first tool preferably includes a platform with a supporting surface for the carrier, and the socket is provided in the platform. Still further, the first tool preferably comprises a ram which is surrounded by the platform and has a surface serving to contact the other side of the head of the connector in the socket. The platform is movable relative to the ram to thereby vary the distance between the surface of the platform and the surface of the ram and to thus move the shank of the connector in the socket toward the respective side of the carrier overlying the surface of the platform.

The machine further comprises at least one source of connectors, means for feeding discrete connectors from the source into the range of the introducing means, at least one source of male components, at least one source of female components, and means for selectively feeding male and female components from the respective sources into the range of the delivering means. The delivering means can advance discrete male or female components between the jaws of the gripper means, and the deforming member of the second tool is preferably reciprocable with reference to the jaws of the gripper means and has a front end face which serves to deform the shank of a connector while such shank extends partially beyond the aperture of the component which is being held down by the back support of the second tool. The back support can comprise a ring and the deforming member preferably comprises or constitutes a plunger which is reciprocable axially within the confines of the ring. In accordance with a presently preferred embodiment of the improved machine, the ring is reciprocable within limits axially of the deforming member and has an annular end face which contacts the male or female component which is held by the gripper means during movement of the one tool toward the extended position so that the end face of the ring surrounds the aperture of such component. The end face of the ring is preferably formed with an annular groove which is bounded by a first and a second annular surface. The male coupling element of the male component which is held by the gripper means is in contact with

and is held against deformation by one of the first and second annular surfaces during movement of the one tool toward its extended position and the female coupling element of a female component which is held by the gripper means is in contact with and is held against deformation by the other of the first and second annular surfaces during movement of the one tool toward its extended position. The first annular surface of the ring preferably surrounds the second annular surface, and the female coupling element of a female component which is held by the gripper means preferably contacts and is held against deformation by the first annular surface. The end face of the ring is preferably further formed with an annular recess which surrounds the aforementioned groove and receives the outer marginal portion of the male or female component which is held by the gripper means.

The machine preferably further comprises means for inactivating the feeding means for male components when the feeding means for the female components is active or operative and vice versa. The machine preferably also comprises means for receiving components from the source or sources of male components or from the source or sources of female components, and means for blocking the admission of components from n-1 sources while the receiving means receives components from the remaining (selected) source (n is the total number of sources of male and female components). The receiving means can be provided with a channel for reception of male or female components from a selected source, and the delivering means can comprise a pusher which is reciprocable in the channel and serves to transfer discrete components from the channel and into the space between the jaws of the gripper means.

The first tool preferably further comprises preferably tubular confining means (e.g., a metallic or plastic sleeve) which axially movably surrounds the ram and a coil spring or other suitable means for yieldably biasing the confining means in a direction toward the second tool to a position in which the confining means extends beyond the connector-engaging surface of the ram and surrounds the connector in the socket.

The second tool preferably further comprises means for limiting the extent of axial movability of the ring of the back support and the deforming member relative to each other (such limiting means can comprise an elongated slot in the ring and a radially extending pin provided on the deforming member and received in the slot). Still further, the second tool can comprise a package of dished springs or other suitable means for yieldably biasing the ring in a direction toward the first tool so that the ring normally assumes a predetermined (lower) end position with reference to the deforming member in which the deforming member is spaced apart from the male or female component which is held by the gripper means.

The machine can be equipped with several sources of different connectors (e.g., each such source can contain a supply of differently colored connectors) and means for feeding connectors from a selected source into the range of the introducing means. Such machine preferably further comprises means for blocking the admission of connectors from all but the selected source of connectors. The feeding means preferably includes a discrete feeding unit for each of the sources and means for receiving connectors from the selected source of connectors. The introducing means is then arranged to transfer connectors from the receiving means into the socket of the first tool. Such receiving means can comprise a channel which is dimensioned to receive different types of connectors, i.e., connectors from any selected source.

The male and female components of fasteners are preferably of the type having a convex side facing the connector in the socket of the first tool and a concave side facing the end face of the ring of the second tool when a male or female component is held by the gripper means, and the one side of the head of each connector is preferably a concave side. This entails a certain bulging of the carrier portion which is clamped between a male or female component and a connector when the component is adequately secured to the connector as a result of movement of the one tool to its extended position.

In order to enhance the versatility of the improved machine, the latter can comprise at least two sources of different male or female components (e.g., each such source can contain a supply of differently colored male or female components), at least one additional source of female or male components, discrete component feeding means for each source, means for receiving components from the feeding means, and means for activating one of the feeding means at a time so that the receiving means is supplied with components from one of the at least two sources or from the additional source. Each feeding means preferably comprises means for singularizing the respective male or female components and for supplying to the receiving means onc component at a time (not unlike the singularizing means which supplies discrete bottle caps from a source of randomly distributed caps to the cap applying station of a bottle capping machine).

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved machine itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is an enlarged axial sectional view of a centrally apertured annular female component which can be applied to a textile or other carrier in a machine embodying the present invention;

FIG. **2** is a bottom plan view of the female component which is shown in FIG. **1**;

FIG. **3** is an enlarged axial sectional view of a centrally apertured annular male component which can be applied to a textile or other carrier in a machine embodying the present invention;

FIG. **4** is a fragmentary top plan view of the female component which is shown in FIGS. **1** and **2**;

FIG. **5** is an enlarged partly axial sectional and partly elevational view of a rivet-shaped connector which can be used to secure male or female components of fasteners to textile or other carriers in a machine which embodies the present invention;

FIG. **6** is a top plan view of the connector which is shown in FIG. **5**;

FIG. **7** is a bottom plan view of the connector which is shown in FIG. **5**;

FIG. **8** is an enlarged axial sectional view of a fully assembled fastener including a female component, a male component, a first connector which secures the

female component to a selected portion of a penetrable carrier and a second connector which secures the male component to another selected portion of the same penetrable carrier or to a portion of a second penetrable carrier;

FIG. **9** is a fragmentary axial sectional view of the tools in a machine which embodies one form of the invention, the upper tool being shown in the retracted position, a male component being held by the gripper means of the upper tool and a connector being received in the socket of the lower tool;

FIG. **10** is an enlarged view of a detail in the machine of FIG. **9**, showing the upper tool in a first intermediate position and a portion of a penetrable carrier between the two tools;

FIG. **11** illustrates the structure of FIG. **10** but with the upper tool in a second intermediate position in which the shank of the connector has penetrated through the carrier and into the centrally located aperture of the male component which is held by the gripper means of the upper tool;

FIG. **12** is an enlarged view of a detail in the structure of FIG. **11**, showing the upper tool in the extended position and with a portion of the shank of the connector upset so that it overlies the adjacent portion of the upper side of the male component;

FIG. **13** is a similar view but showing the upper tool in extended position subsequent to attachment of a connector to a female component which abuts against the end face of the ring-shaped back support of the upper tool;

FIG. **14** is a fragmentary plan view of the means for receiving male or female components from the respective feeding means and further showing a portion of the means for delivering discrete male or female components to the gripper means of the upper tool, a male component being located in the receiving means in the path of movement of delivering means toward the gripper means;

FIG. **15** illustrates the structure of FIG. **14** but with a female component located in the receiving means in front of the retracted delivering means;

FIG. **16** illustrates the structure of FIG. **15**, with the delivering means in extended position it assumes at the instant of insertion of the female component between the jaws of the gripper means;

FIG. **17** is a fragmentary plan view of means for inserting discrete connectors into the socket of the lower tool, the means for actually introducing the connectors into the socket being shown in the retracted position;

FIG. **18** illustrates the structure of FIG. **17** but with the introducing means in extended position at the instant of insertion of a discrete connector into the socket of the lower tool;

FIG. **19** is a sectional view as seen in the direction of arrows from the line XIX—XIX of FIG. **14**, showing the means for inactivating the device for feeding male or female components into the receiving means of FIGS. **14** to **16**;

FIG. **20** is a sectional view as seen in the direction of arrows from the line XX—XX of FIG. **19** and shows the means for blocking the admission of male or female components into the receiving means; and

FIG. **21** is a fragmentary schematic partly elevational and partly sectional view of a modified machine with several sources of male and female components, with several sources of connectors and with means for selecting the connectors and the male or female components which are to be fed to the respective tools.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. **1** and **2** show the female component **20** of a composite fastener of the type shown in FIG. **8**. The female component **20** is an annular body made of a synthetic plastic material and having a round outer marginal portion **21** and a centrally located circular aperture **24**. The concave inner side **25** of the component **20** has an annular female coupling element **22** consisting of three identical arcuate sections (see FIG. **2**) which are partially separated from each other by radially extending slots **28**. The outer marginal portion **21** has a ring-shaped circumferential bead **23** which spacedly surrounds the female coupling element **22**. The convex outer side **26** of the female component **20** is formed with relatively shallow concentric grooves **27**. That portion of the inner side **25** which immediately surrounds the respective end of the aperture **24** is flat or substantially flat and is overlapped by the deformed portion of the shank **36** of the corresponding connector **30** (shown in FIGS. **5** to **7**) when the parts **20** and **30** are properly secured to each other so as to constitute one-half of a complete fastener.

The annular male component **10** of the fastener is also made of a synthetic plastic material; it has the same outer diameter as the female component **20** and it is also provided with a central aperture **14** whose diameter matches or closely approximates the diameter of the aperture **24** in the female component. The outer marginal portion **11** of the male component **10** has a circumferentially complete bead **13** and its convex outer side **16** is formed with concentric grooves **17**. The male coupling element **12** of the component **10** is a circumferentially complete annulus which is spacedly surrounded by the bead **13**, which spacedly surrounds the aperture **14** and which extends from the concave inner side **15** of the male component **10**. The male coupling element **12** has a convex inner flank **18** which diverges in a direction away from the inner side **15**, and the maximum-diameter part of the coupling element **12** is formed with a rounded engaging portion **19** which penetrates into the female coupling element **22** of the associated female component **20** when the components **10** and **20** are assembled into a fastener in a manner as shown in FIG. **8**.

The multi-section female coupling element **22** of the component **20** yields when it is engaged by the rounded portion **19** on the male coupling element **12** of the corresponding male component **10**. The sections of the female coupling element **22** thereupon move back nearer to each other to engage the concave outer flank of the male coupling element **12** and to thus hold the components **10** and **20** against accidental separation from one another. As can be seen in FIG. **1**, the surfaces bounding the bottom zones of the radial slots **28** between the arcuate sections of the female coupling element **22** are stepped. The depth of the radially outermost portions of the slots **28** equals or approximates half the axial length of the female coupling element **22**, and the radially innermost portions of such slots extend all the way or close to the inner side **25** of the female component **20**. In contrast to the male coupling element **12** (whose outer flank is an outwardly curving frustoconical surface), the outer side or flank **29** of the female coupling element **22** is a true or substantially true frustoconical surface

whose diameter diminishes at a constant rate in a direction away from the concave inner side **25**.

The connector **30** of FIGS. **5** to **7** resembles an undeformed rivet and has a cap-shaped rivet head **31** with a concave inner side **32** and a convex outer side **34**. The centrally located shank or stem **36** extends from the concave side **32** and has a pointed (preferably conical) tip **37**. The connector **30** is made of a synthetic plastic material which is ductile so that the tip **37** of the shank **36** can be permanently deformed into engagement with the concave inner side **15** of a male component **10** or with the concave inner side **25** of a female component **20**. The concave side **32** of the head **31** has a plurality of preferably regularly distributed projections **33** in the form of pointed studs which penetrate into the material of a textile or other suitable carrier **70** (see FIGS. **8** and **10–13**) to hold the connector **30** against angular movement relative to the carrier. The exposed convex side **34** of the head **31** has a relief **35** consisting of rounded lumps or protuberances which can be arrayed in a manner as shown in FIG. **7**, i.e., they can form rows extending radially of the head **31** and the diameter of each protuberance which is nearer to the periphery of the head **31** is greater than the diameter of the neighboring protuberance. It can be said that the protuberances of the refief **35** which is shown in FIG. **7** form a plurality of circles, that the diameters of protuberances in each circle are the same, and that the diameters of protuberances in each larger-diameter circle exceed those of protuberances in the immediately adjacent smaller-diameter circle.

A fully assembled fastener is shown in FIG. **8**. This fastener comprises a male component **10**, a female component **20**, a first or lower connector **30** which is secured to the male component **10**, and a second or upper connector **30** which is secured to the female component **20**. The shank **36** of the lower connector **30** extends through the central aperture **14** of the male component **10** and is deformed radially outwardly, as at **38** (i.e., its pointed tip **37** has been converted into a short cylinder with a circumferential bead **38**), so that it overlies the concave inner side **15** in the region immediately around the aperture **14**. The projections **33** have penetrated in part into the material of a textile sheet- or web-like carrier **70** which can constitute a portion of a garment and is clamped between the concave inner side **32** of the head **31** of the lower connector **30** and the convex outer side **16** of the male component **10**. The upper connector **30** of FIG. **8** is deformed in the same way as the lower connector, i.e., a portion of its shank **36** is converted into a bead **38** which overlies the concave inner side **25** of the female component **20** immediately adjacent to the central aperture **24**. The projections **33** of the upper connector **30** penetrate in part into a second carrier **70** which is clamped between the upper connector **30** and the convex outer side **26** of the female component **20**. The second carrier **70** can form part of the garment which includes the first (lower) carrier **70** of FIG. **8**. The circumferentially complete male coupling element **12** of the male component **10** is received and held between the arcuate sections of the female coupling element **22**. The sections of the female coupling element **22** yield by being flexed radially outwardly when the two carriers **70** are pulled apart with a force sufficing to overcome the resistance which the sections of the female coupling element **22** offer to deformation by the rounded portion **19** of the male coupling element **12**.

The source of connectors **30** is a magazine (see the magazine **113** of FIG. **21**), and the components **10** and **20** are supplied by two additional discrete sources (such as the magazines **105** and **109** of FIG. **21**). Feeding units **81, 82** (FIGS. **14–16** and **19–21**) for the male components **10** and female components **20** are provided to supply the respective components from the corresponding magazines into the channel of a trough-shaped device **84** constituting a means for receiving discrete components **10** or **20** from the feeding unit **81** or **82**. The trough-shaped receiving device **84** forms part of an inserting unit **80** whose function is to supply the corresponding tool (**40**) of the improved machine with male or female components **10** or **20**. The channel of the trough-shaped receiving device **84** is elongated and its width is such that it can receive a single male component **10** from the feeding unit **81** or a single female component **20** from the feeding unit **82**. The thus introduced or admitted component **10** or **20** is located in the path of reciprocatory movement of a pusher **87** which constitutes a means for delivering male components **10** or female components **20** into the chamber or space **65** between the jaws **42** of a gripper or tongs **41** forming one of three main constituents of the respective (upper or second) tool **40** of the improved machine. The feeding units **81** and **82** comprise elongated rails **85, 86** which define for the respective (male and female) components **10, 20** elongated partially arcuate and partially straight paths (see FIG. **21**) along which the components advance toward and into the channel of the receiving device **84**. The rails **85** and **86** are designed to deliver the respective components **10** and **20** in a predetermined orientation, namely so that the corresponding coupling elements **12** and **22** face toward the observer of FIGS. **14** to **16**. The rails **85** and **86** define suitable channels or chutes (see particularly FIG. **20**) wherein a single row of the respective components descends or slides (preferably by gravity) toward the channel of the receiving device **84**. The manner in which the components **10** and **20** are transferred from the respective sources or magazines **105, 109** into the channels of the rails **85** and **86** may be the same or similar to the manner of delivering bottle caps from a magazine which contains randomly distributed and oriented caps into a singularizing device which delivers a series of caps in predetermined orientation to the bottle capping station in a brewery, dairy or another bottling plant.

As can be seen in FIGS. **19** and **20**, the machine comprises an inactivating device or barrier **90** which is installed in the region where the channels defined by the rails **85** and **86** of the feeding units **81, 82** for the male and female components **10, 20** discharge into the channel of the receiving device **84**. The purpose of the barrier **90** is to prevent the admission of male components **10** into the channel of the receiving device **84** when such channel receives female components **20** and vice versa. The barrier **90** comprises a reciprocable plunger **91** which supports two axially adjustable radially extending supporting arms **92, 93** respectively supporting blocking pins **94** and **95**. The arms **92, 93** extend in opposite directions from the respective portions of the plunger **91**, and the blocking pins **94, 95** extend in opposite directions as considered axially of the plunger **91**. The exposed portions of the blocking pins **94** and **95** are reciprocable in suitable holes or bores which are provided therefor in the corresponding rails **85** and **86**. Such blocking pins extend at right angles to the paths of movement of the respective male and female compo-

nents **10** and **20** in the channels of the respective rails **85** and **86**.

The plunger **91** is movable between two end positions by an activating or control unit **98** including an electromagnet **96** and a restoring coil spring **97**. The armature of the electromagnet **96** can include or constitute the plunger **91**; however, in the embodiment which is shown in FIGS. **19** and **20** the armature **96***a* of the electromagnet **96** is adjustably connected to the plunger **91** by a retainer **99** which is separably affixed to the armature **96***a* in a manner as shown in the upper portion of FIG. **20** and which is separably connected with the adjacent end portion of the plunger **91** by a screw **88**. The coil spring **97** surrounds the exposed portion of the armature **96***a* and reacts against the housing of the electromagnet **96** to urge the retainer **99** and hence the plunger **91** downwardly, as viewed in FIG. **19**, to one of the two end positions. The plunger **91** assumes the other end position in response to energization of the electromagnet **96**, i.e., when the armature **96***a* moves the retainer **99** upwardly and causes the coil spring **97** to store energy. The activating or control unit **98** including the electromagnet **96** and the restoring spring **97** determines whether the channel of the receiving device **84** is supplied with male components **10** or with female components **20**.

If the receiving device **84** is to be supplied with one or more male components **10**, the activating control unit **98** ensures that the electromagnet **96** is deenergized, i.e., the spring **97** can dissipate energy and moves the plunger **91** downwardly, as viewed in FIGS. **19** and **20**, to the end position of FIG. **20** in which the blocking pin **95** extends into the channel of the rail **86** but the blocking pin **94** is located at a level below the channel of the rail **85**. The diameter of the blocking pin **95** is such that this pin can spear the nearest female component **20** by penetrating into it central aperture **24**. This is shown in FIG. **14** which further shows that the foremost male component **10** has entered the channel of the receiving device **84** and is located in front of the delivering member **87** which is held in the fully retracted position at a maximum distance from the jaws **42** of the gripper or tongs **41** of the corresponding tool **40**. As mentioned above, the male and female components **10** and **20** advance in the channels of the respective rails **85** and **86** by gravity, i.e., the slope of such channels suffices to ensure predictable advancement of components **10** and **20** toward the channel of the receiving device **84**.

If the receiving device **84** is to be supplied with one or more female components **20**, the activating or control unit **98** energizes the electromagnet **96** which retracts the armature **96***a* and plunger **91** against the opposition of the restoring spring **97** whereby the blocking pin **95** is extracted from the channel of the rail **86** to release the row of female components **20** for gravitational advancement toward the receiving device **84**. At the same time, the blocking pin **94** moves upwardly, as viewed in FIG. **20**, and spears the nearest male component **10** by entering its centrally located aperture **14**. This can be seen in FIG. **15**. The row of female components **20** in the channel of the rail **86** is then free to advance by gravity and in stepwise fashion so that the foremost or lowermost female component **20** of such row enters the channel of the receiving device **84** whenever the delivering member **87** assumes the retracted position of FIG. **15**. The member **87** then performs a forward stroke to assume its extended position **87'** (see FIG. **16**) with the result that the female component **20** which has entered the channel of the receiving device **84** is transferred into the chamber or space **65** between the jaws **42** of the gripper or tongs **41**. The transfer of a female component **20** into the chamber **65** takes place in a predetermined position of the respective tool **40**. The means for reciprocating the delivering member **87** in synchronism with movements of certain parts of the tool **40** can comprise a set of cams (not specifically shown) mounted on a camshaft which is driven at a constant or at a variable speed. Reference may be had to the aforementioned commonly owned copending patent application Ser. No. 599,176 of Ernst Herten which describes and shows a system of cams for reciprocating certain parts of the upper tool of a pair of confronting tools in a riveting press and for imparting synchronous movements to certain other constituents of the press. The member **87** is returned to the retracted position of FIG. **14** or **15** as soon as it completes the delivery of a male or female component into the chamber **65** between the jaws **42** of the gripper **41**. This enables the foremost male component **10** or the foremost female component **20** of the rows of such components in the channels of the respective rails **85**, **86** to enter the channel of the receiving device **84** so that the admitted male or female component is ready for transfer into the chamber **65**.

The positions of the blocking pins **94** and **95** with reference to the paths of male and female components **10**, **20** in the channels of the respective rails **85** and **86** can be adjusted by loosening the screw **88** and shifting the plunger **91** axially to a position at a greater or lesser distance from the armature **96***a* of the electromagnet **96**.

The dimensions of the outer marginal portions **11** and **21** of the male and female components **10**, **20** are the same or substantially identical so that the jaws **42** of the gripper **41** can properly hold a male component **10** or a female component **20**. Also, the diameters of the central apertures **14** and **24** in the components **10** and **20** are the same or practically identical so that one and the same type of connectors **30** can be used for attachment to the components **10** and **20**. Moreover, this renders it possible to simplify the construction of the inactivating means **90** because the diameter of the blocking pin **94** can match that of the blocking pin **95**. These blocking pins automatically find their way into the central apertures **14** and **24** of the nearest male and female components **10** and **20** in the channels of the respective rails **85** and **86** because the nearest component **10** or **20** is located at a predetermined distance from the channel of the receiving device **84**. The axial length of the male coupling elements **12** preferably matches or closely approximates the axial length of the female coupling elements **22**; this ensures that the male components **10** can slide in the channel of the receiving device **84** with the same facility as the female components **20** and also that the dimensions of the channel in the rail **85** can match or closely approximate those of the channel in the rail **86**.

The inserting unit **78** which serves to introduce discrete connectors **30** into the socket **53** of the other (first or lower) tool **50** of the improved machine is shown in FIGS. **17** and **18**. This unit is analogous to the inserting unit **80** of FIGS. **14** to **16** and **19–20** except that the channel of its trough-shaped receiving device **89** communicates with the discharge end of a single connector-supplying channel, namely the channel which is defined by the rail of the feeding unit **83** which accepts a row of properly oriented connectors **30** from the corresponding source or magazine **113**. The channel which is de-

fined by the rail of the feeding unit **83** slopes downwardly, i.e., the magazine **113** is located at a level sufficiently above the level of the tool **50** to ensure that the connectors **30** can advance toward and into the channel of the receiving device **89** by gravity feed. The orientation of each connector **30** which enters the channel of the receiving device **89** is such that its shank **36** extends upwardly (this can be readily seen in FIGS. **17** and **18** as well as in FIGS. **9** to **11**). The connector **30** which enters the channel of the receiving device **89** is located in front of the suitably configurated leader **101** of a reciprocable pusher **100** which constitutes a means for introducing successive connectors **30** into the socket **53** of the tool **50**. As can be seen in FIG. **17**, the leader **101** of the pusher **100** has a notch which receives a portion of the shank **36** of the connector in the receiving device **89** to safely and predictably guide the connector on its way into the socket **53**. The means for reciprocating the pusher **100** in the channel of the receiving device **89** is not specifically shown; such reciprocating means can be analogous to the aforediscussed reciprocating means for the pusher **87** and can receive motion from the same camshaft in synchronism with movements of parts of the tools **40** and **50** relative to each other. The extended position of the pusher **100** is shown in FIG. **18**, as at **100'**.

FIG. **9** shows certain parts of the improved machine, and more particularly the construction of the two confronting tools including the first or lower tool **50** which defines the socket **53** for reception of connectors **30** from the channel of the receiving device **89** and the second or upper tool **40** which includes the aforementioned gripper or tongs **41** with jaws **42** bounding the chamber **65** for male or female components **10** or **20** which are supplied by the receiving device **84** and pusher **87**.

The gripper **41** of the tool **40** is mounted on a holder **43** which is reciprocable in directions indicated by a double-headed arrow **44**. The jaws **42** of the gripper **41** are movable toward and away from each other (substantially at right angles to the directions indicated by the arrow **44**) and, to this end, are mounted at the lower ends of leaf springs **66** whose upper ends are affixed to the holder **43**. The jaws **42** surround a vertically reciprocable deforming member **45** which includes a smaller-diameter lower end portion or working end **48** serving to deform the uppermost portion or tip **37** of the shank **36** forming part of the connector **30** which is received in the socket **53** of the lower tool **50** when the deforming member **45** performs a downward stroke. The directions of reciprocatory movement of the deforming member **45** and its working end **48** are indicated by the double-headed arrow **47**. The upper end portion of the deforming member **45** is separably affixed to a holder **46** which, together with the holder **43**, constitutes or forms part of the means for reciprocating the three main parts of the upper tool **40** relative to the lower tool **50**. The phase and amplitude of reciprocatory movements of the deforming member **45** deviate from the phase and amplitude of the reciprocatory movements of the gripper **41**.

The smaller-diameter working end **48** of the deforming member **45** is surrounded by a ring-shaped back support or hold-down device **60** having an annular lower end face **69** which is in contact with the male component **10** or female component **20** while the component is held in the chamber **65** between the jaws **42** of the gripper **41** and the working end **48** of the deforming member **45** is in the process of upsetting the tip **37** of a shank **36** after the shank **36** has penetrated through the material of a carrier **70** between the tools **40**, **50** and has also penetrated through and partially upwardly and beyond the aperture **14** or **24** of the component **10** or **20**.

The back support **60** constitutes an important third part of the upper tool **40** and includes an upwardly extending sleeve-like extension **61** which surrounds the larger-diameter main portion of the deforming member **45** and whose enlarged upper end portion or boss has an elongated slot **62** for a diametrically extending pin **49** in the deforming member **45**. The surfaces bounding the slot **62** and the pin **49** constitute a means for limiting the extent of movability of the deforming member **45** and back support **60** relative to each other. The maximum extent of such movability is shown at **63** in FIG. **11**. The boss at the upper end of the extension **61** abuts against the lowermost dished spring of a package **102** of dished springs which surround the upper portion of the deforming member **45** and whose uppermost spring bears against the underside of the holder **46** for the member **45**. The package **102** of dished springs tends to maintain the back support **60** in the lower end position (FIG. **9**) with reference to the deforming member **45**, i.e., in a position in which the end portions of the transverse pin **49** are received in the uppermost parts of the respective portions of the slot **62** in the extension **61** of the back support **60**. The package **102** can yield to a predetermined force which urges the back support **60** upwardly with reference to the deforming member **45** so that the back support **60** then assumes the upper end position or an intermediate position which latter is shown in FIG. **11**. The back support **60** participates in the majority of movements of the deforming member **45** in directions which are indicated by the arrow **47**.

The reference characters **67** denote mounting blocks which are carried by or from part of the holder **43** and support the upper end portions of leaf springs **66** for the jaws **42** of the gripper **41**.

The discharge end of the channel which is defined by the receiving device **84** of FIGS. **14** to **16** is adjacent to the chamber **65** between the jaws **42** of the gripper **41**. The chamber **65** is a substantially cylindrical space which is located at a level above conical inner sides or faces **64** of the jaws **42**. The surfaces bounding the chamber or space **65** guide the external surface of the back support **60** when the jaws **42** are free to assume the positions of FIG. **9**, i.e., at a minimum distance from one another.

FIG. **9** shows the tool **40** in its upper end position in which the lower end faces of the jaws **42** are spaced apart from the horizontal upper surface **51***a* of a platform **51** forming part of the lower tool **50** and surrounding the socket **53** so that a carrier **70** can be inserted into the space between the tools **40**, **50** in such a way that the carrier overlies the surface **51***a* of the platform **51** and the connector **30** in the socket **53**. The tool **40** is ready to receive a male component **10** or a female component **20** between the jaws **42** of its gripper **41** when it dwells in the upper end position of FIG. **9**. The pusher **87** then moves to the extended position **87'** of FIG. **16** and delivers a male component **10** or a female component **20** into the chamber **65** by way of an inlet **104** (FIG. **14**) whose width increases during introduction of the component **10** or **20**, i.e., the leaf springs **66** are flexed to allow the jaws **42** to move away from each other and to thus permit introduction of the component **10** or **20** into the chamber **65** at a level above the conical faces **64**. A

properly inserted male component **10** is shown in FIG. **9** directly above the conical faces **64** of the jaws **42** in the lowermost portion of the chamber **65**. At such time, the lower end face **69** of the back support **60** is spaced apart from the upper (concave) side **15** of the male component **10** in the chamber **65**.

In addition to the platform **51**, the tool **50** comprises a cylindrical ram **54** which has a concave top surface **57** for the convex outer side **34** of the head **31** of the connector **30** in the socket **53**. The platform **51** is biased upwardly by one or more springs, not shown, in a manner as disclosed in the aforementioned copending patent application Ser. No. 599,176 of Ernst Herten so that it normally assumes the upper end position which is shown in FIG. **9**. The platform **51** then abuts against a suitable stop (not shown) in the frame **56** of the improved machine. The directions of movement of the platform **51** under and against the opposition of the just mentioned spring or springs (e.g., a set of two or more coil springs) are indicated by a double-headed arrow **52**. The platform **51** descends, to cause the corresponding spring or springs to store energy, under the action of the upper tool **40** when the latter descends and shifts the platform below the upper end position of FIG. **9** through the medium of a carrier **70** resting on the supporting surface **51***a*.

The platform **51** has a lateral inlet **103** (see FIGS. **17** and **18**) which establishes communication between the socket **53** and the channel of the receiving device **89** so that a connector **30** which has entered the device **84** from the discharge end of the channel in the rail of the feeding unit **83** can enter the socket **53** when the introducing means or pusher **100** of the inserting unit **78** moves to the extended position **100'** of FIG. **18**.

The cylindrical ram **54** of the tool **50** is mounted on a stationary support **55** which is removably installed in the frame **56** of the machine so that the ram **54** can be replaced with a different ram if the machine is to employ connectors that deviate substantially from the illustrated connectors **30**. The ram **54** has a smallest-diameter lower end portion which is a press fit in or is otherwise fixedly installed in the support **55**, a larger-diameter median portion which is surrounded by a coil spring **59** reacting against the support **55**, and a maximum diameter upper end portion which is formed with the concave supporting surface **57** for the convex side **34** of the head **31** of the connector **30** in the socket **53**. The maximum-diameter portion of the ram **54** is surrounded by a tubular confining member **58** in the form of a sleeve which is reciprocable relative to the ram **54** under the action or against the opposition of the coil spring **58** and has a lower end portion in the form of an annular inwardly extending collar **58***a* cooperating with a shoulder **54***a* between the maximum-diameter upper end portion and the intermediate portion of the ram **54** to thus determine the upper end position of the confining member **58**. In such upper end position, the uppermost part of the confining member **58** extends upwardly beyond the concave upper surface **57** of the ram **54** and surrounds the outer marginal portion of the head **31** in the socket **53** of the tool **50**.

The discharge end of the channel which is defined by the receiving device **89** of FIGS. **17** and **18** extends at right angles to the plane of FIG. **9** and registers with the inlet **103** leading to the socket **53** when the platform **51** is allowed to assume the upper end position of FIG. **9**. The freshly inserted connector **30** descends onto the concave surface **57** of the ram **54** and its outer marginal portion is surrounded by the upper end portion of the tubular confining member **58** because the latter then assumes the upper end position of FIG. **9** in which the collar **58***a* abuts against the shoulder **54***a* under the action of the coil spring **59**. The upper end face **58***b* of the confining member **58** is then at least substantially flush with the radially outermost portion of the concave inner side **32** of the head **31** in the socket **53**. The confining member **58** cooperates with the ram **54** to properly center the connector **30** in the socket **53** of the lower tool **50**.

The carrier **70** (see FIG. **10**) can be inserted between the tools **40** and **50** by hand so that it overlies the surface **51***a* of the platform **51** and that a selected (preferably marked) portion of the carrier overlies the connector **30** in the socket **53**. As mentioned above, the carrier **70** can constitute a panel of a garment which is made of a textile or snythetic plastic material. The marking on the carrier **70** can be in the form of a circle which is to register with the socket **53** before the upper tool **40** begins to descend toward the first intermediate position of FIG. **10**. The tool **40** can begin to perform a downward stroke in automatic response to detection of proper positioning of the carrier **70** on the surface **51***a* of the platform **51** or in response to depression of a pedal or another suitable starting element (not shown) which is depressed or otherwise displaced by the person manipulating the carrier **70**.

In the intermediate position of the tool **40** which is shown in FIG. **10**, the jaws **42** of the gripper **41** bear against the upper side of the carrier **70** at a level above the supporting surface **51***a* of the platform **51** and maintain the platform at a level below its upper end position. Thus, the platform **51** is shifted downwardly relative to the ram **54** (which is mounted on the fixed support **55**) and relative to the tubular confining member **58** which is held in the upper end position (collar **58***a* abuts against the shoulder **54***a*) under the action of the coil spring **59**. The platform **51** thereby stresses the aforementioned spring or springs which tend to maintain it in the upper end position of FIG. **9**. In view of the descent of platform **51** to a level below its upper end position, the pointed tip **37** of the shank **36** of the connector **30** in the socket **53** is immediately adjacent to or in actual contact with the underside of that portion of the carrier **70** which overlies the socket **53** of the lower tool **50**.

FIG. **10** further shows that the first stage of downward movement of the upper tool **40** from the upper end positicn of FIG. **9** involves a downward movement of the back support **60** relative to the gripper **41** so that the annular lower end face **69** of the back support catches up with and abuts against the male component **10** in the lowermost part of the chamber **65**.

The manner in which the end face **69** engages the male component **10** between the jaws **42** of the gripper **41** is shown on a larger scale in FIG. **12**. Thus, the male coupling element **12** of the component **10** extends into an annular groove **71** which is machined into the lower end face **69** and spacedly surrounds the bore for the working end **48** of the deforming member **45**. The groove **71** is flanked by an inner annular surface **72** which is in contact with the convex inncr flank **18** of the male coupling element **12** not later than when the tool **40** assumes the intermediate position of FIG. **10** whereby the annular surface **72** centers the coupling element **12** and hence the entire male component **10** in the chamber **65** of the gripper **41**. This ensures that the shank **36** of the connector **30** in the socket **53** of the

lower tool **50** can find its way into the central aperture **14** of the male component **10**. The annular radially innermost portion **73** of the back support **60** in the region of the lower end face **69** is then surrounded by the male coupling element **12** of the component **10** and extends downwardly and slightly beyond the end face **79** of the working end **48** of the deforming member **45** when the tool **40** reaches the lower end position of FIG. **12**. The annular portion **73** is surrounded by the coupling element **12** and thereby prevents deformation of such coupling element in a direction toward the axis of the working end **48**.

The end force **69** of the ring-shaped back support **60** is further formed with an annular recess **74** which is adjacent to the periphery of the back support **60** and receives the bead **13** of the outer marginal portion **11** of the male component **10** in the chamber **65**. This also contributes to the centering action of the back support **60**.

The jaws **42** of the gripper **41** cooperate with the platform **51** to stretch the material of the carrier **70** which rests on the supporting surface **51***a* of the platform **51** and to thus facilitate penetration of the pointed tip **37** of the shank **36** of the connector **30** in the socket **53** through the carrier **70** when the upper tool **40** descends from the first intermediate position of FIG. **10** to the second intermediate position of FIG. **11**. The convex side **16** of the male component **10** is then adjacent to or is in actual contact with the upper side of the carrier **70** and the shank **36** has entered the central aperture **14** of the male component **10** which is then located at a level below the jaws **42** of the gripper **41**. The penetration of the tip **37** of the shank **36** through the carrier **70** is completed when the tool **40** reaches the second intermediate position of FIG. **11**. The jaws **42** and the male component **10** have lowered the platform **51** so that the carrier **70** has descended from the phantom-line position to the solid-line position **70'** in which it continues to overlie the supporting surface **51***a* of the platform **51** and is already pierced by the shank **36** of the connector **30** in the socket **53**. FIG. **11** shows the gripper **41** of the upper tool **40** in the lower end position but the deforming member **45** still has a certain freedom of downward movement relative to the jaws **42** (to the lower end position of FIG. **12**) in order to deform the tip **37** of the shank **36** so that the tip **37** is converted into the cylinder which was described in connection with FIG. **8** and has an annular bead **38** overlying the adjacent portion of the concave side **15** of the male component **10** immediately adjacent to the central aperture **14**.

Expulsion of the male component **10** from the chamber **65** of the gripper **41** has taken place during movement of the tool **40** from the first intermediate position of FIG. **10** to the second intermediate position of FIG. **11**. More specifically, such expulsion of the male component **10** took place due to the fact that the extent of downward movement of the back support **60** is greater than the extent of downward movement of the gripper **41** so that the lower end face **69** of the back support **60** slides in the chamber **65** and pushes the entire male component **10** along the conical faces **64** of the jaws **42** and out of the chamber **65**. The jaws **42** can move apart against the opposition of the respective leaf springs **66** and thereupon again move nearer to each other as soon as the lower end portion of the back support **60** is again retracted into the normally cylindrical chamber **65** of the gripper **41**. The provision of conical faces **64** at the inner sides of the jaws **42** facilitates the spreading action of the male component **10** which is being pushed downwardly by the ring-shaped back support **60** so that the jaws **42** move apart gradually at a rate which is determined by the inclination of their conical faces **64** and by the rate of downward movement of the back support **60** with reference to the gripper **41**. When the back support **60** reaches the lower end position of FIG. **11**, its cylindrical peripheral surface is engaged by the conical faces **64** of the jaws **42** so that such jaws are held apart as long as the back support continues to dwell in its lower end position. The movement of the back support **60** to the lower end position of FIG. **11** entails penetration of the shank **36** of the connector **30** in the socket **53** into and partially upwardly beyond the axial aperture **14** of the male component **10** so that the tip **37** of such shank is in an optimum position for axial and radial deformation by the lower end face **79** of the working end **48**. In fact, and as shown in FIG. **11**, the back support **60** can reach its lower end position at the exact moment when the lower end face **79** of the working end **48** of the deforming member **45** comes in contact with the tip **37** of the shank **36** at a level above the aperture **14** of the male component **10**.

The extent of downward movement of the back support **60** relative to the deforming member **45** during movement of the upper tool **40** from the first intermediate position of FIG. **10** to the second intermediate position of FIG. **11** is shown in FIG. **11**, as at **63**. Such shifting of the deforming member **45** relative to the back support **60** takes place because the male component **10** at the lower end of the ring-shaped back support **60** encounters a resistance to downward movement by the stretched carrier **70** on the surface **51***a* of the platform **51** and/or by the connector **30** in the socket **53**. This entails a certain deformation of the package **102** of dished springs which store energy while the deforming member **45** descends relative to the arrested or slower back support **60** through the aforementioned distance **63**.

During the last stage of downward movement of the upper tool **40** (actually of the deforming member **45**), namely from the position of FIG. **11** to the position of FIG. **12**, the working end **48** acts upon and deforms the tip **37** of the shank **36** so that the shank is provided with the aforediscussed radially outwardly extending bulge or beard **38** which overlies the radially innermost portion of the inner side **15** of the male component **10** to thus ensure the establishment of a reliable mechanical connection between the parts **10** and **30** and to simultaneously ensure that the portion of the carrier **70** which has been pierced by the shank **36** is reliably clamped between the convex outer side **16** of the male component **10** and the concave inner side **32** of the head **31** of the connector **30**. Moreover, the projections **33** of the connector **30** penetrate into the material of the carrier **70** and thus prevent angular movements of the connector **30** and male component **10**. When the deforming action of the working end **48** upon the shank **36** is completed, the pin **49** of the deforming member **45** is located in or close to the lowermost portion of the slot **62** in the extension **61** of the back support **60**.

During deformation of the shank **36** by the working end **48** of the deforming member **45**, the bead **13** on the outer marginal portion **11** of the male component **10** rests in the annular recess **74** of the lower end face **69** of the back support **60** so that the male component **10** is held against radial movement relative to the back support while the working end **48** performs its deforming

or upsetting action. The surface bounding the recess **74** further serves to urge the underside of the marginal portion **11** of the male component **10** against the radially outermost portion of the concave side **32** of the head **31** of the connector **30** in the socket **53** so that the convex outer side **34** of the head **31** is urged against the complementary concave surface **57** of the ram **54** below the socket **53**.

As mentioned above, the inner annular surface **72** in the groove **71** is engaged by the rounded portion **19** of the male coupling element **12** to prevent deformation of the coupling element **12** radially inwardly toward the axis of the aperture **14**. Thus, when the working end **48** of the deforming member **45** brings about a cold flow of the synthetic plastic material of the shank **36** so as to form the bead **38** which overlies the radially innermost portion of the inner side **15** of the male component **10**, the latter is reliably held in an optimum position with reference to the connector **30** in the socket **53** and its male coupling element **12** is reliably held against deformation such as would prevent it from adequately engaging the female coupling element **22** of a female component **20** in a manner as shown in FIG. **8**. The descending working end **48** of the deforming member **45** expels plastic material of the shank **36** from the space within thc confines of the annular portion **73** of the back support **60**, and such material then tends to flow radially outwardly to form the annular bead **38** which reliably locks the shank **36** to the male component **10**. The shank **36** then resembles a mushroom and overlies the radially innermost portion of the inner side **15** of the male component **10**. The bead **38** may but need not extend all the way to the convex inner flank of the male coupling element **12**. The flat end face **39** of the mushroom-shaped (deformed) shank **36** is sufficiently close to the inner side **15** to provide room for the mushroom-shaped shank of the other connector **30** when the male component **10** of FIG. **12** is assembled with a female component **20** in a manner as shown in FIG. **8**, i.e., the axial length of each mushroom-shaped (deformed) shank **36** is selected with a view to ensure that such shanks cannot contact each other and thus cannot interfere with attachment of the male and female components **10**, **20** to each other.

The annular surface **72** in the groove **71** of the end face **69** of the back support **60** performs the important and desirable function of preventing deformation of the male coupling element **12** in a direction toward the axis of the aperture **14** when the end face **69** of the back support **60** engages the adjacent side of the male component **10** as well as during subsequent deformation of the shank **36** to convert the pointed tip **37** into the bead **38** and the adjacent cylindrical portion as shown in FIGS. **8** and **12**. Absence of deformation of the male coupling element **12** is important because this ensures that the element **12** can be properly engaged with a female coupling element **22** as well as that such engagement and (if necessary) a subsequent disengagement does not necessitate the application of excessive forces. Still further, the surface **72** in the groove **71** of the end face **69** of the back support **60** renders it possible to make the male components **10** of a readily available inexpensive synthetic plastic material whose resistance to permanent deformation is just sufficient to ensure adequate engagement between the male and female coupling elements **12** and **22**.

The projections **33** at the concave inner side **32** of the head **31** of the connector **30** penetrate into the material of the carrier **70** when the upper tool **40** reaches the lower end position of FIG. **12**. The convex outer side **16** of the male component **10** then bears against the upper side of the carrier **70** opposite the concave inner side **32** of the head **31**. As mentioned above, the projections **33** hold the connector **30** against rotation relative to the carrier **70**.

The sleeve-like tubular confining member **58** of the lower tool **50** performs the following functions: The marginal portion of the head **31** of the connector **30** in the socket **53** of the lower tool **50** would be likely to penetrate into and leave a permanent mark in or even destroy the adjacent portion of the carrier **70**. The ram **54** cannot contact the carrier **70** because it does not extend radially beyond the head **31** of the connector **30** in the socket **53**. The upper end face **58***b* of the confining member **58** is flush with the upper side of the marginal portion of the head **31** when the confining member **58** assumes the upper end position of FIG. **9**, **10**, **11** or **12**. The end face **58***b* is flat and thus prevents the formation of a pronounced circular mark in and/or more serious damage to the material of the carrier **70** in the region where the carrier is adjacent to the radially outermost portion of the head **31**. Moreover, the confining member **58** reliably centers the head **31** in the socket **53** to thereby ensure that the shank **36** is in register with the aperture **14** of the male component **10** which is held by the jaws **42** and which is thereupon expelled from the chamber **65** and assumes the position of FIG. **11** (at a level below the jaws **42**). The confining member **58** can yield against the opposition of the coil spring **59** whenever the need arises to even further reduce the likelihood of permanent deformation of or even more pronounced damage to the adjacent portion of the carrier **70**. The direction in which the confining member **58** can yield against the opposition of the spring **59** is indicated by the arrows **76** (see FIG. **12**). Yieldability of the confining member **58** is desirable and advantageous because this ensures that the end face **58***b* cannot leave a permanent impression in the adjacent portion of the carrier **70**. The fact that the end face **58***b* of the confining member **58** moves to a level below the upper side of the head **31** in the socket **53** when the coil spring **59** is caused to store energy is of no consequence insofar as the centering action of the confining member **58** upon the connector **30** in the socket **53** is concerned because the shank **36** has already penetrated into the aperture **14** of the male component **10** when the spring **59** begins to yield and permits movement of the end face **58***b* to a level below the uppermost portion of the head **31** in the socket **53**.

The length of the stroke of the gripper **41** of the upper tool **40** between its upper and lower end positions is shown at **68** (FIG. **9**).

When the conversion of the shank **36** into the mushroom-shaped body of FIG. **12** is completed, the tool **40** is returned to its upper end position whereby the aforediscussed spring or springs automatically return the platform **51** to the upper end position of FIG. **9**. During the first stage of return movement of the parts of the tool **40** to the positions of FIG. **9**, the dished springs of the package **102** are permitted to dissipate energy and to thus lift the deforming member **45** with reference to the ring-shaped back support **60** whereby the pin **49** returns into the uppermost portion of the elongated slot **62** in the extension **61** of the back support **60**. The upward movement of the deforming member **45** with reference to the back support **60** is followed by upward move-

ment of the gripper **41** and back support. The latter begins to rise as soon as the pin **49** reaches the upper end portion of the slot **62** and the deforming member **45** continues to move upwardly. Upward movement of the back support **60** and gripper **41** entails that the coil spring **59** for the confining member **58** is free to expand (provided that the confining member **58** was moved from its upper end position with reference to the stationary ram **54** of the lower tool **50**) and the platform **51** is also free to rise to the upper end position of FIG. **9**. This completes a cycle and the carrier **70** is then removed and replaced with a different carrier or is shifted relative to the supporting surface **51***a* of the platform **51** so that another predetermined (preferably marked) portion of such carrier overlies the socket **53** and is ready to be traversed by the shank **36** of a fresh connector **30** which is to be coupled to a male component **10** or to a female component **20**.

The manner in which a female component **20** is introduced into the chamber **54** between the jaws **42** of the gripper **41** is the same as the manner of introducing a male component **10**. The difference is that the blocking pin **94** then extends into the aperture **14** of the adjacent male component **10** in the channel of the rail **85** so that the feeding unit **81** is ineffective but the feeding unit **82** is free to admit discrete female components **20** into the channel of the receiving device **84** at the rate which is determined by the frequency of movement of the delivering means (pusher **87**) to the retracted position of FIG. **14** or **15**.

Once a female component **20** is properly received in the chamber **65**, the upper tool **40** descends to the intermediate position of FIG. **10** so that the lower end face **69** of the back support **60** engages and centers the female component in a manner as best shown in FIG. **13**. Thus, the annular portion **73** is surrounded by the composite female coupling element **22** which extends into the groove **71** and whose conical outer flank **29** abuts against the annular outer surface **77** in the groove **71** to thus prevent deformation of the female coupling element **22** in a direction radially of and away from the axis of the central aperture **24**. The recess **74** in the end face **69** receives the bead **23** of the outer marginal portion **21** of the female component **20** to even further reduce the likelihood of misalignment of this component with reference to the connector **30** in the socket **53** of the lower tool **50**.

The parts of the upper tool **40** then assume the intermediate positions of FIG. **11** whereby the shank **36** of the connector **30** in the socket **53** penetrates through the carrier **70** which overlies the surface **51***a* of the platform **51** and enters the central aperture **24** of the female component **20** at the underside of the back support **60**. The tool **40** thereupon assumes the lower end position of FIG. **13** whereby the working end **48** of the deforming member **45** upsets the tip of the shank **36** to form the bead **38** which overlies the inner side **25** of the female component **20** in immediate proximity of the aperture **24**.

The slots **28** of the female coupling element **22** enhance the tendency of the arcuate sections of this coupling element to move apart. Since the female component **20** is preferably made of a deformable synthetic plastic material, the sections of the female coupling element **22** could move apart and would prevent adequate engagement with the coupling element **12** of a male component **10** as a result of excessive or pronounced deformation of the tip of a shank **36** which extends through the aperture **24** of the female component **20** at the underside of the back support **60**. The annular outer surface **77** in the groove **71** of the end face **69** of the back support **60** prevents such undesirable deformation of the female coupling element **22** so that one and the same upper tool **40** can adequately hold and attach male components **10** and/or female components **20** by the simple expedient of providing the end face **69** of the back support **60** with a groove **71** which is bounded in part by the annular surface **72** (which prevents undesirable deformation of male coupling elements **12**) and in part by the annular surface **77** (which prevents undesirable deformation of the arcuate sections of female coupling elements **22**).

The aforedescribed configuration of the male components **10**, female components **20** and connectors **30** renders it possible to use a single type of connectors **30** for attachment to the male components **10** or to the female components **20** with the same degree of reliability and by utilizing a single set of confronting tools **40** and **50**. The ability of the male and female coupling elements **12**, **22** to adequately engage each other is not affected by the fact that the same tool (**40**) is used for application of male or female components to selected portions of a single carrier or to different carriers. Furthermore, the mechanical connection between a connector **30** and a male component **10** is just as reliable as that between a connector **30** and a female component **20**. The reliability of attachment of the male or female components **10** and **20** to a single piece of fabric or to different carriers is not affected by the frequency at which the activating or control unit **98** is operated to shift from the application of male components **10** to the application of female components **20** or vice versa.

The back support **60** not only ensures that the male coupling elements **12** or female coupling elements **22** are not deformed during attachment of the respective male or female components to a carrier but the back support also prevents undue deformation of the remaining portions of male or female components. This is due to the fact that the beads **13** or **23** of the outer marginal portions **11** or **21** are received in the annular recess **74** of the end face **69** at the underside of the back support **60** so that the latter props the adjacent component **10** or **20** at two radially spaced apart circumferentially complete locations. The back support **60** further ensures predictable deformation of the shanks **36** because its annular portion **73** controls the direction of cold flow of the material of a pointed tip **37** which is being deformed by the working end **48** of the member **45** during the last stage of movement of the tool **40** to its lower end position. This enhances the reliability of the connection between a male or female component and the corresponding connector **30** and contributes to the establishment of identical connections irrespective of whether the connectors **30** are to be affixed to male components **10** or female components **20**. Still further, the back support **60** ensures that the height of deformed shanks **36** is not excessive, i.e., (and as already described with reference to FIG. **8**) that the deformed shanks **36** of two connectors **30** in a fully assembled article of hardware remain spaced apart from each other and thus cannot interfere with attachment of the male coupling elements **12** to the female coupling elements **22**.

It is clear that each of the various parts of the upper tool **40** and/or lower tool **50** can receive motion from a discrete drive. The illustrated arrangement is preferred at this time because it contributes to simplicity, com-

pactness and lower cost of the machine. Thus, the extent of reciprocatory movement of the platform **51** can be controlled by the parts of the upper tool, the extent of axial movement of the confining member **58** relative to the fixed ram **54** can be controlled by the material of the carrier **70**, the extent of movability of the back support **60** relative to the deforming member **45** and/or vice versa can be controlled by a simple pin-and-slot connection **49**, **62**, and the opening and closing of the gripper **41** can be controlled by a component **10** or **20** and by the back support **60**.

The utilization of components **10**, **20** with convex outer sides **16**, **26** and of connectors **30** whose heads **31** have concave inner sides **32** is desirable and advantageous because this contributes to more reliable retention of carriers **70** between such parts as well as to more accurate and predictable orientation of the connectors and male or female components relative to each other.

The concentric grooves **27** in the convex outer sides **26** of the female components **20**, the concentric grooves **17** in the convex outer sides **16** of the male components **10** and/or the protuberances **35** at the convex outer sides **34** of the heads **31** of connectors **30** can serve a purely decorative purpose. Such grooves and protuberances are optional (see FIG. **8**).

FIG. **21** shows certain parts of a modified machine **75** which can utilize the confronting tools **40**, **50** of FIGS. **9** to **13** but which is capable of supplying to the tool **40** two or more different types of male components **10**, **10'** and/or two or more different types of female components **20**, **20'**. Furthermore, the machine of FIG. **21** can supply to the tool **50** two or more different types of connectors **30**, **30'**. For example, the male components **10**, **10'** can consist of different (e.g., metallic and plastic) materials or they may be furnished in different colors. The same applies for the female components **20**, **20'** and for the connectors **30**, **30'**.

The sources **105**, **105'** of male components **10**, **10'** are two discrete magazines or two compartments of a single magazine. Analogously, the sources of female components **20**, **20'** include two discrete magazines **109**, **109'** or two compartments of a single magazine. The sources of connectors **30**, **30'** are two discrete magazines **113**, **113'** or two compartments or chambers of a single magazine.

Feeding units **106** and **106'** are provided to advance discrete rows of male components **10**, **10'** from the respective magazines **105**, **105'** to a junction **107** where the feeding units **106**, **106'** merge into the aforementioned feeding unit **81** including the channeled guide rail **85**. A barrier or gate **108** (indicated schematically by an arrow) is provided at the junction **107** to shift a suitable switching device between a first position in which the feeding unit **106** can deliver male components **10** to the feeding unit including the rail **85** and a second position in which the feeding unit including the rail **85** receives male components **10'** from the feeding unit **106'**. The barrier **90** at the discharge end of the feeding unit including the rail **85** performs the same function as the barrier **90** of FIGS. **19** and **20**, i.e., it permits only the male components **10** or **10'** or the female components **20** or **20'** to reach the chamber **65** between the jaws **42** of the gripper **41** forming part of the tool **40**.

The magazines **109**, **109'** respectively admit single rows of properly oriented female components **20**, **20'** into the feeding units **110**, **110'** which merge into the feeding unit **82** including the rail **86** at a junction **111** provided with a barrier or gate **112** performing the same function as the gate or barrier **108**, i.e., to admit into the channel of the rail **86** female components **20** which are supplied by feeding unit **110** or female components **20'** which are supplied by the feeding unit **110'**. The feeding unit including the rail **86** extends from the junction **111** to the tool **40**, and the gravitational descent of female components **20** or **20'** therein is controlled by the barrier **90** in the same way as described in connection with FIGS. **19** and **20**.

It is clear that the machine of FIG. **21** can have three or more discrete sources of different male components **10**, **10'**, etc. and one, two, three or more discrete sources of female components **20**, **20'**, etc. or vice versa. The provision of three or more sources of male components necessitates the use of a more complex barrier or gate **108** at the junction of feeding units which receive male components from three or more different sources, and the same holds true if the machine of FIG. **21** is equipped with three or more sources of different female components. By way of example, the structure which is shown in the right-hand portion of FIG. **21** can be duplicated so that the machine **75** then comprises four discrete sources of male components and four discrete sources of female components. The second barrier **90** is or can be provided diametrically opposite the illustrated barrier **90**, i.e., the chamber **65** of the gripper forming part of the tool **40** which is shown in the lower portion of FIG. **21** can receive male components **10** or **10'** or female components **20** or **20'** from its right-hand side, and such chamber can receive additional types of male or female components from its left-hand side, as viewed in FIG. **21**.

The sources **112**, **113'** admit single rows of properly oriented connectors **30**, **30'** into the channels of two discrete feeding units **83**, **83'** which merge at the junction **114** and are controlled by a gate or barrier **115** corresponding to the barrier **108** or **112**, i.e., the socket **53** of the lower tool **50** can receive connectors **30** or connectors **30'** depending on the position or condition of the switching device or blocking means which is controlled by the barrier **115**.

The machine of FIG. **21** can be equipped with a single source of connectors (e.g., connectors **30**) or with three or more sources each of which contains a supply of different connectors. For example, the structure which is shown in the left-hand portion of FIG. **21** can be duplicated to provide a total of four discrete sources of different connectors, four feeding units and two barriers or gates **115** as well as a further barrier (corresponding to the barrier **90**) which determines the type of connectors that are actually admitted into the socket **53**.

The primary reason (or an important reason) for providing the improved machine with two or more sources of male components, female components and/or connectors is to allow for the application of differently colored components or connectors and/or to allow for the admission of components or connectors which are made of different types of plastic and/or metallic material.

The exact nature of control means for the various barriers or gates of the machine **75** which is shown in FIG. **21** forms no part of the present invention. Such control means can constitute or include a suitable circuit which receives signals indicating the need for a particular type of male or female components or connectors, and the circuit then transmits appropriate signals to the barriers or gates **108**, **112**, **90** and **115** to ensure the selection of desired male or female compo-

nents and/or connectors. The circuit can receive input signals from a control panel or automatically in accordance with a selected program.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the appended claims.

I claim:

1. A machine for selectively applying centrally apertured annular male and female components of fasteners to penetrable carriers by means of connectors of the type having a rivet head and a deformable shank extending from one side of the head, comprising confronting first and second tools; means for moving at least one of said tools relative to the other of said tools between a retracted position in which a carrier is insertable between the tools and an extended position, said first tool having a socket for reception of the heads of discrete connectors in such orientation that the shank of the connector in said socket extends toward said second tool and penetrates through the carrier between said tools on movement of said one tool toward said extended position, said second tool having gripper means for releasably holding a male or female component in such orientation that the aperture of the component held by said gripper means registers with and receives the shank of the connector in said socket in response to movement of said one tool toward said extended position, said second tool further having a deforming member movable with reference to said gripper means during movement of said one tool toward said extended position so as to deform the shank of the connector in said socket subsequent to penetration of such shank first through the carrier between said tools and thereupon through and partially beyond the aperture of the component which is held by said gripper means; means for introducing discrete connectors into said socket in the retracted positions of said one tool; and means for delivering discrete male or female components to said gripper means in the retracted positions of said one tool.

2. The machine of claim **1**, wherein said second tool further comprises a back support arranged to hold down the component which is held by said gripper means during penetration of the shank of a connector through and partly beyond the aperture of such component and during subsequent deformation of the shank.

3. The machine of claim **2** for applying male and female components of the type having at least substantially identically dimensioned outer marginal portions engageable by said gripper means and respectively having annular male and female coupling elements facing away from said first tool and being contacted by said back support while the respective marginal portions are held by said gripper means, wherein said first tool includes a platform having a supporting surface for the carrier, said socket being provided in said platform and said first tool further including a ram surrounded by said platform and having a surface arranged to contact the other side of the head of the connector in said socket, said platform being movable relative to said ram to thereby vary the distance between the surface of said platform and the surface of said ram.

4. The machine of claim **2**, further comprising a source of connectors, means for feeding discrete connectors from said source into the range of said introducing means, at least one source of male components, at least one source of female components, and means for selectively feeding male and female components from the respective sources into the range of said delivering means.

5. The machine of claim **2**, wherein said gripper means comprises a tongs having jaws which are movable nearer to and further away from each other to respectively hold and release a component which is placed between said jaws by said delivering means, said deforming member being reciprocable with reference to said jaws and having a front end face arranged to deform the shank of a connector while such shank extends partially beyond the aperture of the component which is held down by said back support.

6. The machine of claim **2**, wherein said back support comprises a ring and said deforming member is reciprocable axially of and within the confines of said ring, said ring being movable within limits axially of said deforming member and having an annular end face which contacts the component that is held by said gripper means during movement of said one tool toward said extended position so that the end face surrounds the aperture of such component.

7. The machine of claim **6** for applying male and female components of the type having at least substantially identically dimensioned outer marginal portions engageable by said gripper means and respectively having annular male and female coupling elements facing away from said first tool while the respective marginal portions are held by said gripper means, wherein the end face of said ring has an annular groove bounded by a first and a second annular surface, the male coupling element of the male component which is held by said gripper means being in contact with one of said first and second surfaces during movement of said one tool toward said extended position and the female coupling element of the female component which is held by said gripper means being in contact with the other of said first and second surfaces during movement of said one tool toward said extended position.

8. The machine of claim **7**, wherein said first annular surface surrounds said second annular surface and the female coupling element of a female component which is held by said gripper means is in contact with said first annular surface while said one tool moves toward said extended position.

9. The machine of claim **7**, wherein the end face of said ring has an annular recess which receives the marginal portion of the male or female component held by said gripper means.

10. The machine of claim **2**, wherein said first tool is disposed at a level below said second tool and further comprising at least one source of male components, at least one source of female components, means for feeding male components from the respective source into the range of said delivering means, means for feeding female components from the respective source into the range of said delivering means, and means for inactivating one of said feeding means while the other feeding means is in the process of feeding the respective components and vice versa.

11. The machine of claim **2**, further comprising at least one source of male components, at least one source of female components, means for receiving components

from either of said sources and means for blocking the admission of components from one of said sources to said receiving means while the receiving means accepts components from the other of said sources and vice versa.

12. The machine of claim **11**, wherein said receiving means has a channel for reception of components from the selected source and said delivering means is arranged to transfer components from said channel to said gripper means.

13. The machine of claim **2**, wherein said first tool includes a platform having a supporting surface for the carrier and surrounding said socket, a ram surrounded by said platform and having a surface arranged to contact the other side of the connector in said socket, substantially tubular confining means axially movably surrounding said ram and means for yieldably biasing said confining means in a direction toward said second tool to a position in which the confining means extends beyond the surface of said ram and surrounds the connector in said socket.

14. The machine of claim **2**, wherein said back support includes a ring having an end face which contacts the component held by said gripper means while said one tool moves toward said extended position, said deforming member being reciprocable within said ring and further comprising means for limiting the extent of movability of said ring and said deforming member relative to each other.

15. The machine of claim **14**, further comprising means for yieldably biasing said ring in a direction toward said first tool so that the ring normally assumes a predetermined end position with reference to said deforming member in which the latter is spaced apart from the component held by said gripper means.

16. The machine of claim **2**, further comprising several sources of different connectors and means for feeding connectors from a selected source into the range of said introducing means.

17. The machine of claim **16**, further comprising means for blocking the admission of connectors from all but the selected source of connectors.

18. The machine of claim **17**, wherein said feeding means includes a discrete feeding unit for each of said sources and means for receiving connectors from the selected source, said introducing means being arranged to transfer connectors from said receiving means into said socket.

19. The machine of claim **18**, wherein said receiving means has a channel which is dimensioned to receive connectors from any one of said sources.

20. The machine of claim **2** for applying male and female components of the type having a convex side facing said first tool, while a component is held by said gripper means, by means of connectors with heads the one side of which is concave, said second tool being disposed at a level above said first tool.

21. The machine of claim **1**, further comprising at least two sources of different male or female components, at least one additional source of female or male components, discrete component feeding means for each of said sources, means for receiving components from said feeding means, and means for activating one of said feeding means at a time so that said receiving means is supplied with components from one of said two sources or from said additional source.

22. The machine of claim **21**, wherein each of said feeding means includes means for singularizing the respective components and for supplying to said receiving means one component at a time.

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